service manual

CLEARSPAN P120L MULTIPOINT RECORDER

Foster
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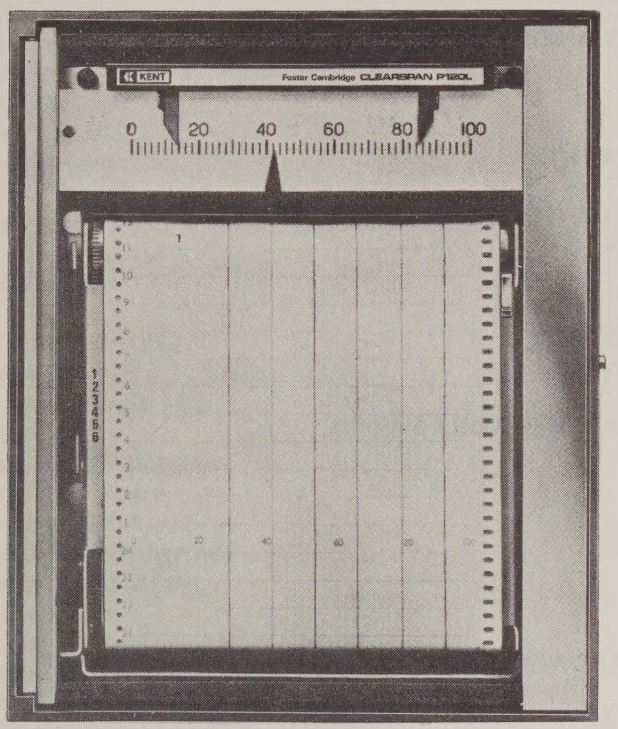
CLEARSPAN P120L MULTIPOINT RECORDER



The service manual covers the P120L series of multipoint recorders and recorder-controllers and is based on procedures which assume that the recommended test equipment is available, and that the customer holds spares as detailed in the spares list.

Sufficient information is included both pictorially and in the text to enable the customer to dismantle to the appropriate stage, to carry out a fault finding procedure, and to re-assemble and test in accordance with the Company's standard practice.

Each instrument is marked with a code number which identifies its type and use and is derived as follows:—

Basic Type No.	No. of measuring Points	Measured Variable	Common Control/Alarm mode and Set Point		
				Low	High
P12 Potentiometric Recorder with 120 mm chart width	2. Two point 3. Three point 6. Six point	1. Thermocouple 2. Resistance Thermometer 3. Linear Voltage 4. Others	17. Recorder only 00. Single Alarm 01. Single Alarm 05. Double Alarms 06. Double Alarms 09. High-Low Alarms 10. High-Low Alarms	— — — B A B A	— A B B A A B

The code number is built up thus: P126 - 101

A—Relay energized above set point. B—Relay energized below set point.

The code number together with the serial number, appears on labels on the front of the chassis behind the chart unit and on the inside of the case.

It is assumed that the customer is in possession of the relevant Operating Instructions which contain full details regarding installation etc.

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Issue 1
July, 1974

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ABBREVIATIONS AND MNEMONICS

The following abbreviations and mnemonics are used in the text and line drawings.

ACJC	Automatic Cold Junction Compensation
AL	Alarm pcb
Amp	Amplifier
E/F	Emitter-Follower
FS	Fanning Strip
HSP	High Set Point(er)
LSP	Low Set Point(er)
PCB	Printed Circuit Board
PL	Plug
PSU	Power Supply Unit
RC	Range Card
RCC	Range Card Connector
RL	Relay
R/T	Resistance Thermometer
SCR	Screen
Sel.Sw	Selector Switch
SKT	Socket
TB	Terminal Block
T/C	Thermo-couple
T/E	Thermo-electric
TRF	Transformer

Bk	Black
Bn	Brown
Rd	Red
Or	Orange
Yl	Yellow
Gn	Green
Bl	Blue
Vl	Violet
Sl	Slate
Wh	White
Pk	Pink

Examples of Mnemonics:–

AL1 Alarm pcb pin 1
PSU5 Power Unit pin 5
RCC7 Range Card Connector pin 7
TB13 Terminal Block pin 13

SPECIFICATION

Number of channels	2, 3 or 6, dotting, time shared; (samples every 10 seconds).
Ribbon colours	2 point: red, black. 3 point: red, black, green. 6 point: red, black, green, brown, orange, violet.
Length of ribbon	6.75 metres – lasts for approximately 3 charts
Chart	Writing width 120mm. Length 15 metres Long charts to special order
Chart speed	Single speed according to chart cassette fitted. Cassettes available to give 5, 10, 20, 30, 60 and 120mm per hour.
Minimum span	5mV. 25°C on 3 lead (BS.1904) thermometers (38.5 ohms F.I.) 50°C on 2 lead (BS.1904) thermometers (38.5 ohms F.I.) 100°C BS.4937 Pt. 3 'J' thermocouple
Intrinsic error	±0.5% span – maximum
Dead band	0.3% span – maximum
Total response time	2 sec. maximum
Operating temperature limits	0–55°C
Operating humidity limits	0–80% R.H.
Zero error due to ambient temperature variation	±0.05% span/°C typical
Warm up time	10 minutes
Power supply voltage and frequency	115V, 200V and 240V nominal; 50 or 60 Hz
Power requirements	20VA
Error due to power supply voltage variation	±0.15% span maximum for + 10% to –20% variation
Spurious signal rejection	
Common Mode:	0.5% span maximum for 10V r.m.s. 50 Hz
Series Mode:	0.5% span maximum for r.m.s. 50 Hz signal equivalent to 25% span
Maximum source resistance	500 ohms on 5mV span without adjustment of zero
Standing current through source	50nA typical when no upscale or downscale drive is fitted
Automatic reference junction compensation	Fitted on all thermoelectric instruments. Typical error resulting from A.C.J.C. circuitry 0.08°C per °C change in ambient temperature
Broken sensor protection	Upscale on thermoelectric recorders with control/alarm action unless otherwise specified
Control/Alarm action	Common to all points. Relay energized above or below set point as required
Contacts	Single pole change-over 240V 5A 50 Hz non-inductive loads
Overall dimensions	252mm x 204mm x 244mm
Weight	9.5 kg.
Panel cut out (DIN)	186mm wide 234mm high

PRINCIPLES OF OPERATION

Input signals from two, three or six thermocouples, resistance thermometers or millivolt sources are fed to a selector switch and applied in turn to a potentiometric ranging circuit, where each signal is compared with a reference voltage picked from a slidewire energised by a stabilised supply. The difference is amplified by a high gain amplifier whose output drives a linear motor. The linear motor carries the indicating pointer dotting arm and indicating pointer contact which rests on the slidewire. It consists of a coil assembly travelling in a magnetic field. The amplifier drives the coil in the appropriate direction to reduce the difference signal to zero.

An input filter circuit reduces any spurious signals picked up by the input leads and diodes are used for overload protection. Automatic cold junction compensation is provided where required.

If resistance thermometers are used, each is connected in turn in the ranging circuit to form one arm of a resistance bridge which is balanced by the action of the slidewire system.

In alarm versions, contacts attached to set pointers bear on the slidewire. Safety resistors are fitted so that in the unlikely event of the slidewire contact going open circuit the power to the load is cut off.

On/Off Alarm Circuits

For on/off alarm the voltage picked up from the slidewire by the moving contact is compared with the relevant set point voltage and fed to the control circuit. This consists of an amplifier with a small delay circuit, followed by a Schmitt trigger which operates a relay when the difference signal changes polarity i.e., as the indicating pointer passes the set point.

The relay has two sets of change-over contacts. One set operates the neon pilot lamp on the front panel and the other set is wired to the customer's terminal block. Alarms use the normally closed contacts to operate a neon, so that the pilot lamp lights when the relay is de-energised. Alarm indicators may have an external power supply to safeguard alarm operation in the event of mains failure.

Instruments with two set points have two independent sets of relays and neons.

Power Supplies

The P120L series of recorders may be operated from a mains AC supply of 115V, 200V or 240V nominal at 50 or 60 Hz. The error due to a power supply voltage variation of +10% to −20% is 0.15% span maximum. The instrument will operate correctly within a frequency range of 48–62 Hz, except in chart speed and dotting interval which changes proportionately with frequency. 50 or 60 Hz motors are fitted as appropriate.

The power consumption of the instrument is approximately 20VA.

DESCRIPTION OF OPERATION

Input Ranging Circuits Millivolt Input – see Fig. 1.

With the linear motor positioned at the lower end of the scale, a small voltage appears across R3 due to the indicating pointer contact not being in precise contact with 0V. In order to balance the inputs to the amplifier when the signal input is zero, the voltage across R3 must equal the voltage across R6. A zeroing current is derived from RV2. RV1 is adjusted until the motor pointer indicates at the top of the scale when the signal input is equivalent to full scale deflection.

Certain applications may require a suppressed zero condition. Where, for example, +5mV is positionally equivalent to zero, it is necessary to increase the voltage across R3 to balance out the 5mV difference; this is achieved by connecting R5 and linking R6. Conversely, where the requirement calls for a negative millivolt indication equivalent to zero, R6 would be increased in value and R5 omitted.

In normal operation the potential difference applied to the input causes an imbalance in the ranging circuitry. The resulting error signal applied to the amplifier drives the linear motor in the appropriate direction to reduce the error to zero.

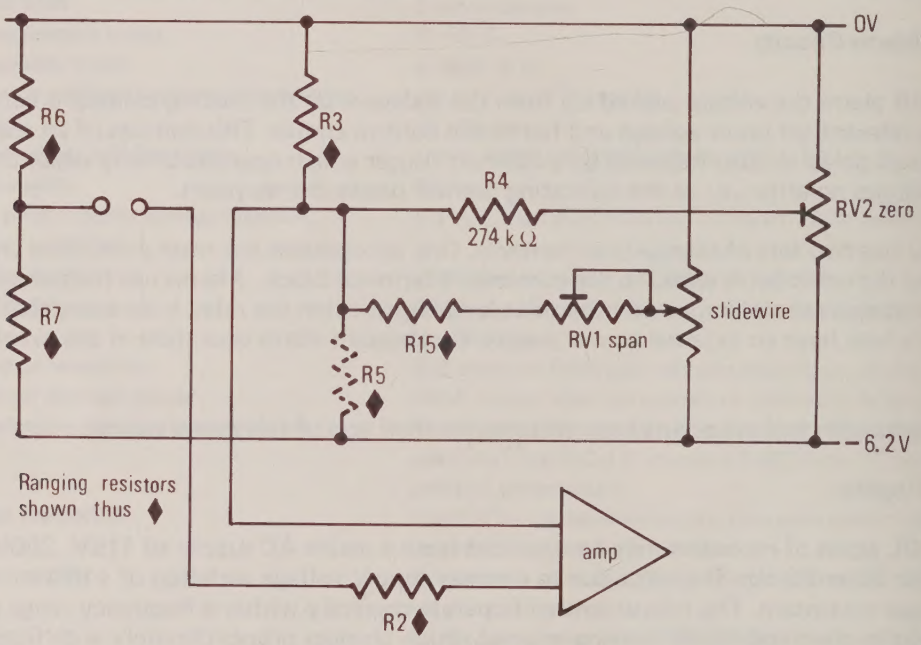


Fig. 1. Millivolt Input

Voltage Input. See Fig. 2

If the input signal is greater than 100mV RX and RY are used in a potential divider configuration and the voltage developed across RY is applied to the input ranging circuit – Fig. 1.

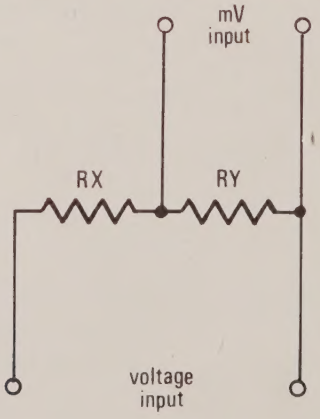


Fig. 2. Voltage Input

Current Input — See Fig. 3

This circuit is basically the same as for a millivolt input, a voltage signal being developed across RY by the input current.

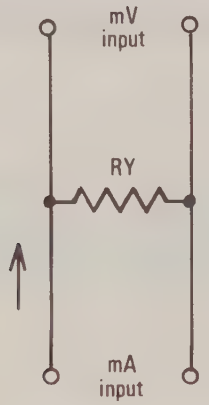


Fig. 3. Current Input

Thermo-electric Input — See Fig. 4

This circuit is basically the same as for a millivolt input. With zero input, the voltage developed across R1 + R3 is balanced by an equal and opposite voltage developed across R6.

Automatic cold junction compensation (ACJC) utilises the variation in base-emitter voltage of a transistor with temperature. R14 supplies current to the transistor which has a nominal voltage of 0.6V. As the base-emitter junction voltage varies with temperature a proportion of the voltage across the junction appears across R1 and provides automatic cold junction compensation.

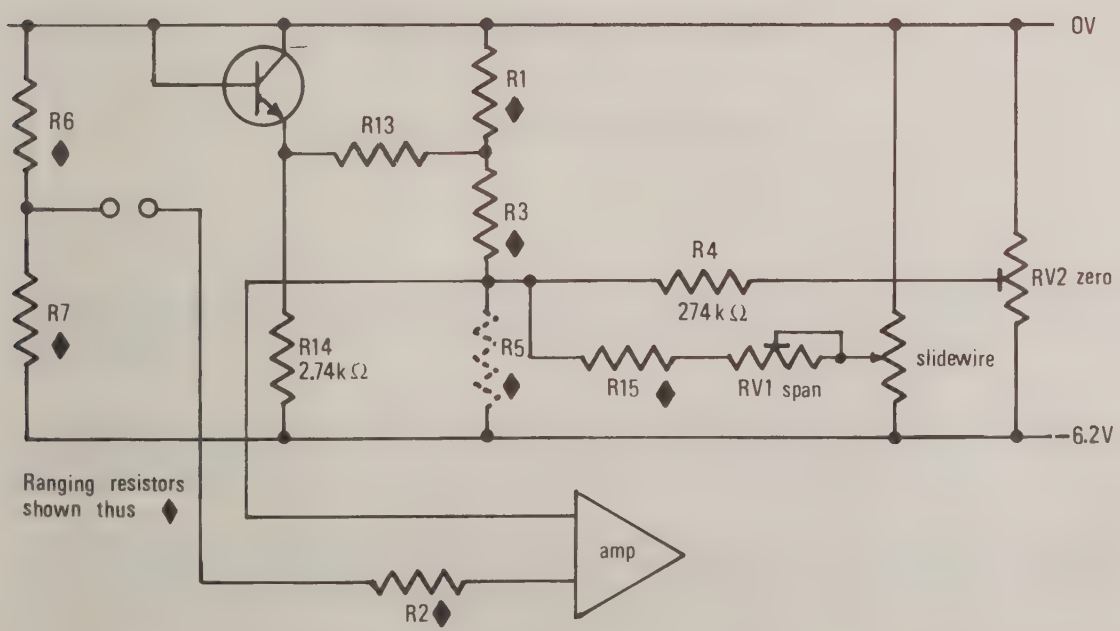


Fig. 4. Thermo-electric Input

Resistance Thermometer Input — See Fig. 5

Resistance thermometer instruments are designed for use with either two lead or three lead resistance thermometers hence the appropriate type must always be used.

With two lead R/T instruments the resistance of the leads is a very important factor since it causes zero shift which must be corrected by lead balancing rheostats. These are fitted at the rear of the instrument and adjusted individually to compensate for variation in lead resistance between resistance thermometers.

Three lead resistance thermometers are wired direct to their respective terminal block connections.

Fig. 5 shows the theoretical connection of an R/T to the input ranging circuit. It is supplied with current via R7 and R2 and as the temperature of the R/T increases the voltage at the junction of R2 and R7 changes producing an imbalance in the bridge circuitry. This error signal is applied to the input of the amplifier which drives the linear motor in the required direction to reduce the error signal to zero.

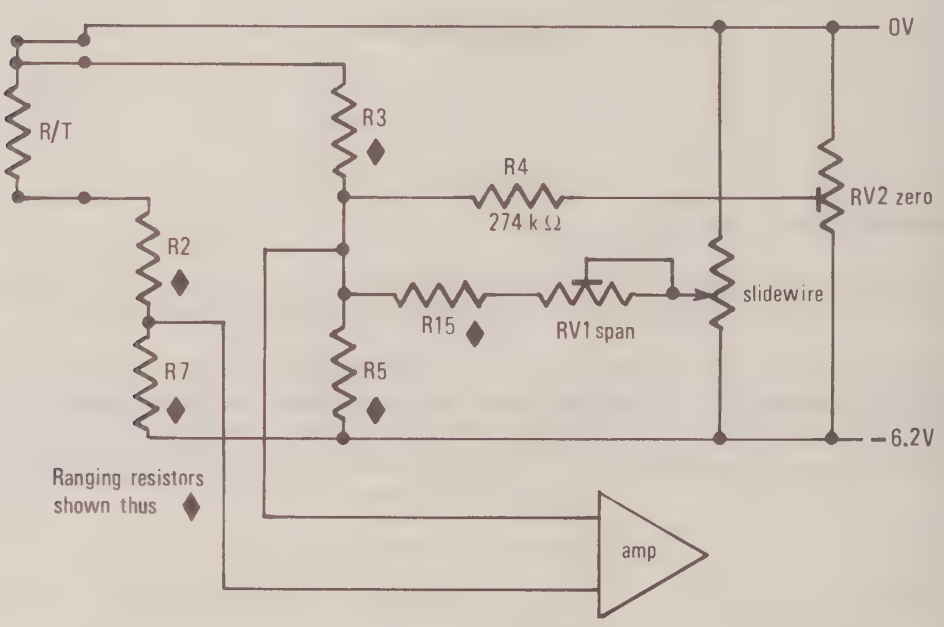


Fig. 5 Resistance Thermometer Input

Measuring Amplifier — see Fig. 6

The error signal from the ranging circuit is fed to a double chopper circuit forming a differential amplifier; this switches alternately between feedback and signal circuits. The output is fed into an a.c. amplifier and detector system, the output from which is applied to a d.c. amplifier and power output stage.

The amplifier output drives the linear motor coil in the appropriate direction so as to reduce the error signal to zero.

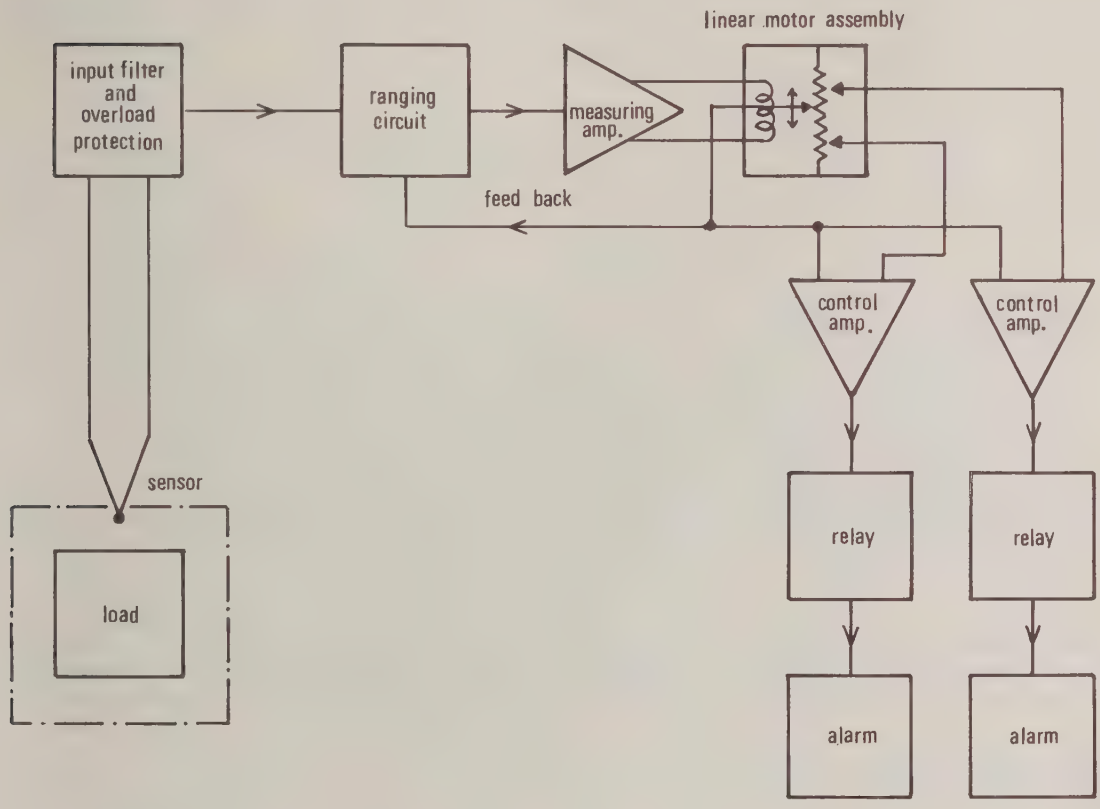


Fig. 6 Recorder plus Double Alarm

Control Amplifier — see Fig. 7

In on/off control or alarm versions the voltage between the indicating pointer contact and the set pointer contact is fed to the control circuit. This consists of a differential amplifier which feeds the relay driver.

The magnitude of the input voltage is dependent upon the relative position of the indicating pointer contact with respect to the set pointer contact and the polarity of the voltage depends on the mode of relay operation, i.e. energisation above (EA) or below (EB) the set point.

In the EA mode the polarity of the potential applied to the control circuit is such that when the indicating pointer contact is below the set point the relay is held OFF. As the indicating pointer contact passes the set point the voltage changes polarity and the relay is energised.

The inverse applies in the EB mode of operation.

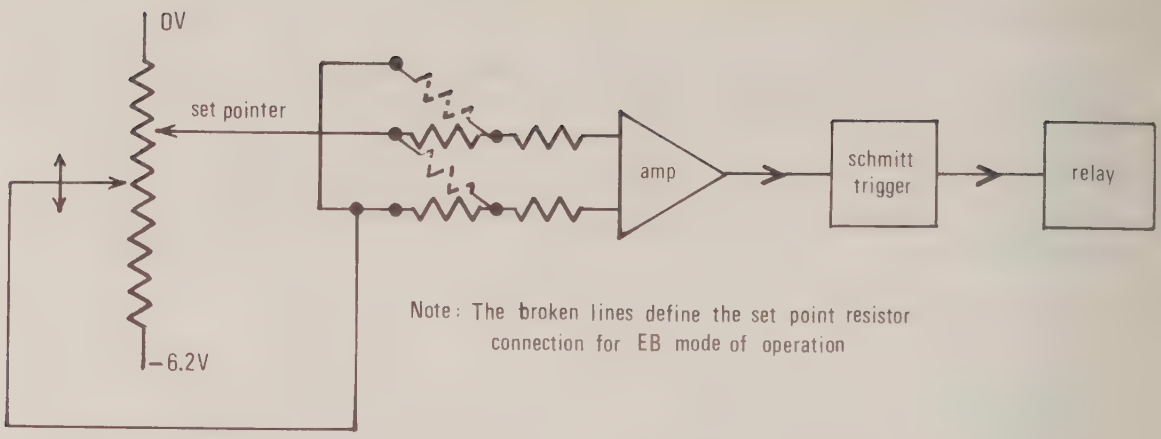


Fig. 7 Mode of Relay Operation

Selector Drive Motor System

A single phase 115V synchronous motor provides the drive to the channel selector switch and to a series of cams which determine the sequence of operation.

The drive motor shaft rotates an indexing mechanism producing intermittent drive to a secondary shaft on which is mounted the two-pole rotary channel selector and colour cams. The colour cams position the ribbon frame, so that the correct ribbon colour is under the dotting mechanism. The channel number indicator operates in conjunction with the ribbon frame to which it is attached.

Two further cams are mounted on the drive motor shaft. The inner cam operates a microswitch to mute the servo system during channel changeover. The outer cam operates the chopper bar system which presses the stylus onto the chart when the servo system has come to balance.

The operating sequence is given below and is depicted in Fig. 8.

(1) Inner cam operates muting switch — linear motor and dotting mechanism at rest.

(2) Indexing mechanism rotates secondary shaft which provides channel selection, associated ribbon colour positioning and channel number indication.

(3) Servo system re-balances and comes to rest at the commensurate position.

(4) Outer cam operates chopper bar and the stylus records the measured value of the selected channel.

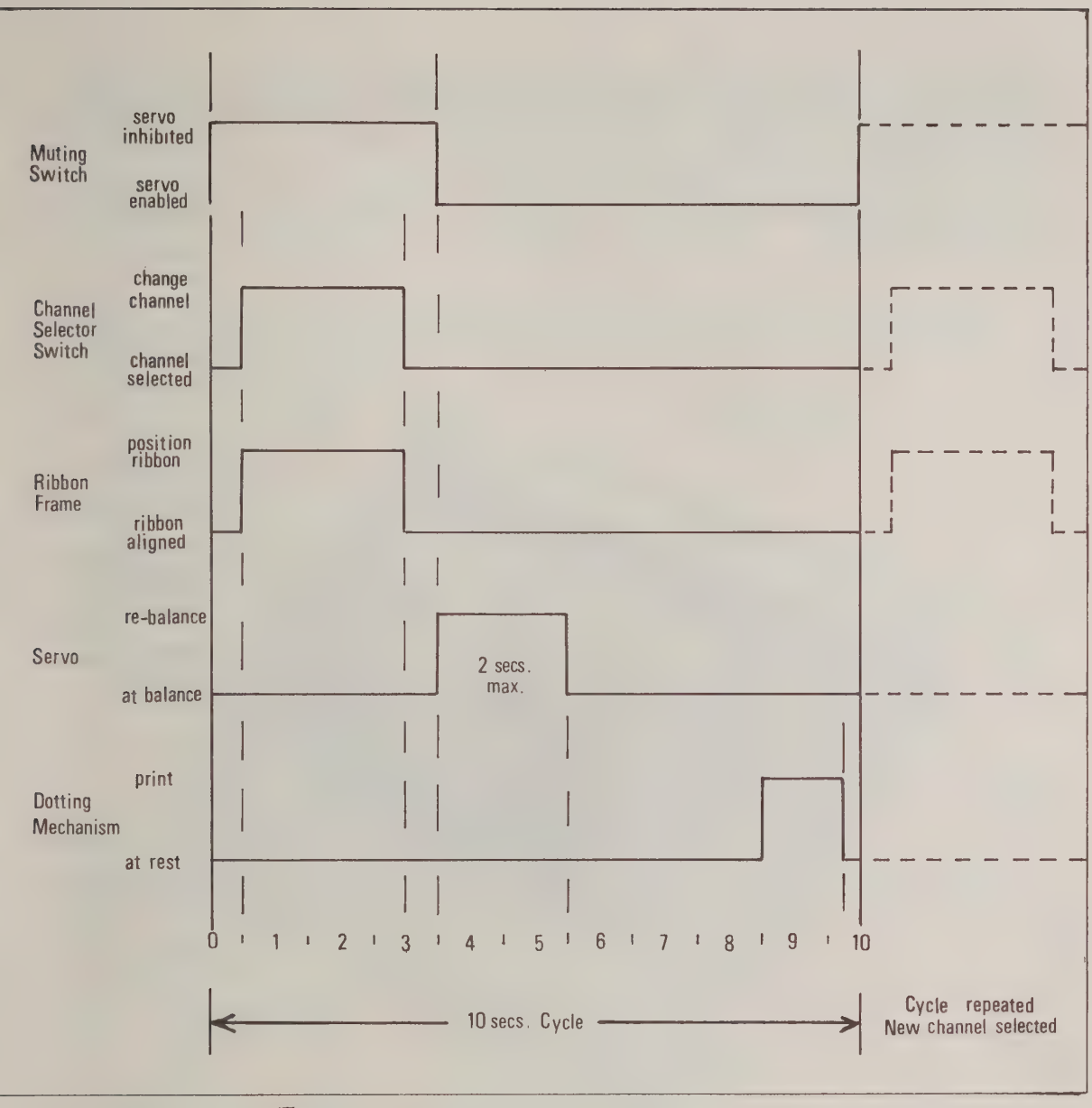


Fig. 8 Recorder Operating Sequence and Cycle Time

Chart Drive Motor System — see Fig. 9

A single phase 240V synchronous motor is used to advance the chart via a fixed ratio train of gear wheels. The necessary reduction gearing to achieve the required chart speed is contained in the motor housing, and if a change in chart speed is required the appropriately geared synchronous motor has to be fitted — see page 58.

The chart drive motor also drives a ratchet mechanism to wind the ribbon from the feed spool on to the take-up spool.

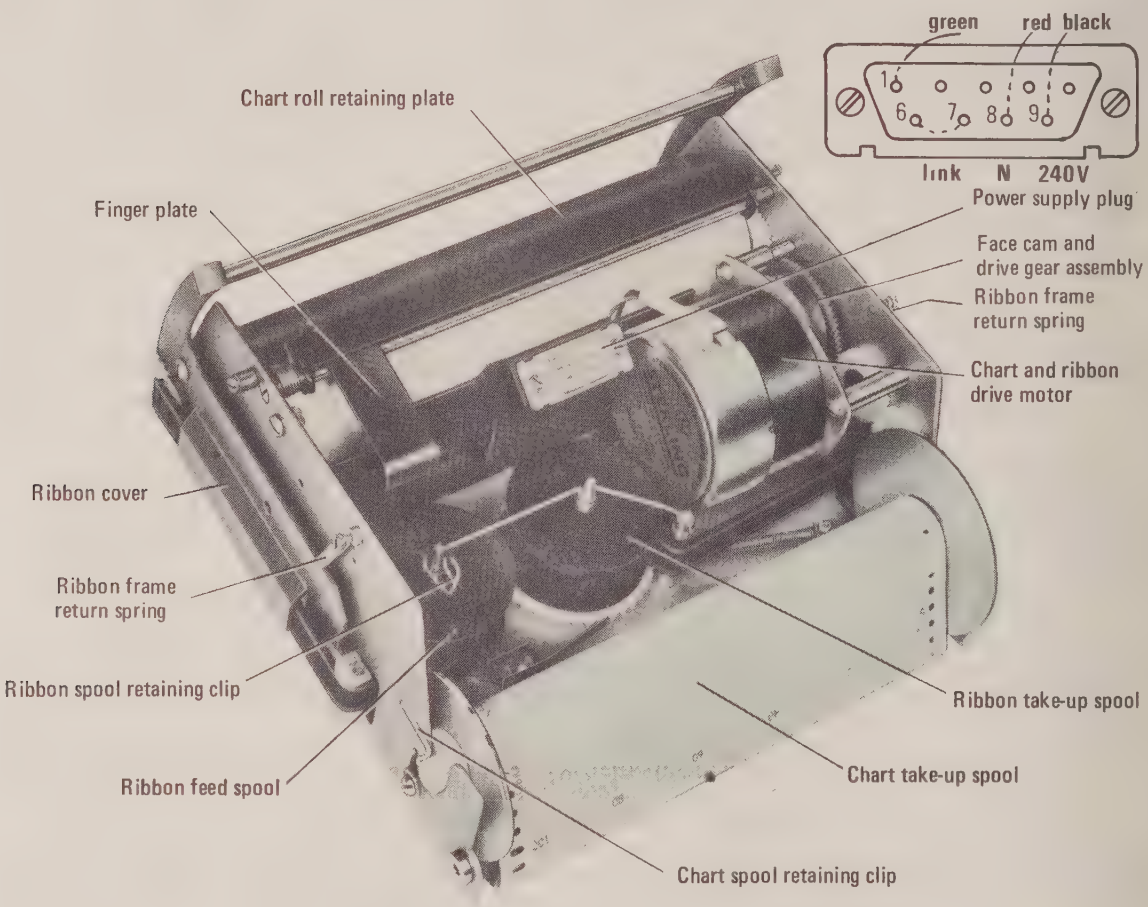


Fig. 9. Chart Unit Assembly

Power Supply Unit — see Fig. 10

The mains AC supply passes to the power supply unit via the customers terminal block, and is applied to the mains transformer. The transformer secondary of 11.5V : 0V : 11.5V provides the nominal operating DC voltages of +15V : 0V : −15V which supply the measuring amplifier and on/off alarm circuits. The −15V rail also supplies a constant current generator and voltage regulating element which provides the high stability voltage reference source of approximately −6.2V for the input ranging circuit and feedback slidewire. A stabilised supply of +6.2V is derived from the +15V rail.

The power supply unit must not be operated under open circuit conditions, i.e. with the amplifier printed circuit board disconnected, otherwise the constant current supply will be damaged.

Selector Drive Motor Supply — see Fig. 10

The supply to this motor is derived from the 115V tapping of the mains transformer and is routed via the chart drive plug and socket connector.

Chart Drive Motor Supply — see Fig. 10

This motor derives its voltage from the 240V tapping of the mains transformer, and is routed via the chart drive plug and socket connector.

If the recorder is connected to a mains supply of less than 240V, the mains transformer acts as an auto transformer to supply power to the chart drive motor.

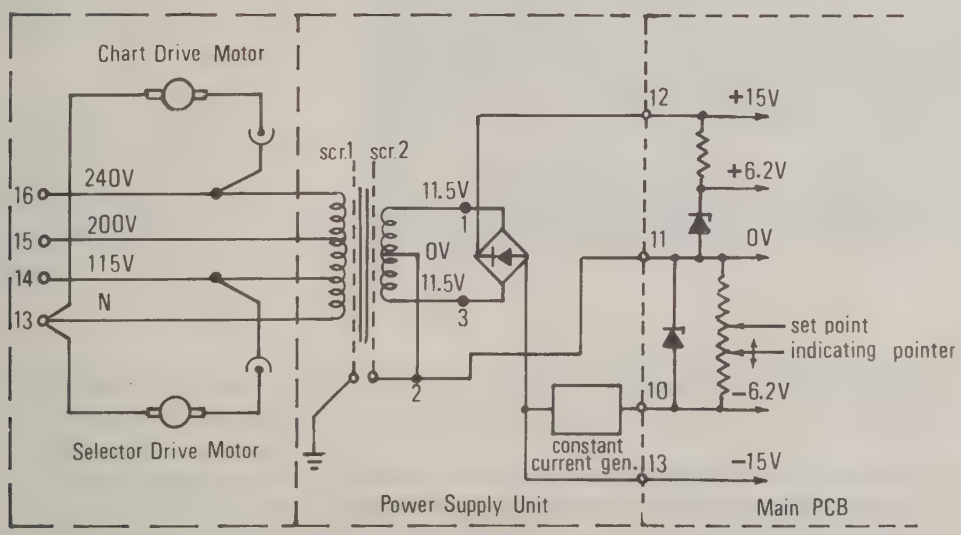


Fig. 10. Power Supplies

FAULT FINDING

Test Equipment

The following items of test equipment are required:

VOLTMETER

An AC/DC voltmeter (sensitivity not less than 20k ohms/volt) capable of measuring 0 to 240 volts AC and 0 to 25 volts DC, e.g. Avometer Model 8 or equivalent.

OHMMETER

An ohmmeter capable of indicating resistance within the range 20 ohms and 20k ohms, e.g. Avometer Model 8 or equivalent.

WORKSHOP POTENTIOMETER

Capable of providing a mV source of 0 to 20mV e.g. Foster Cambridge Portable Potentiometer Type PP320 or equivalent.

DECADE RESISTANCE BOX or TEST COIL (for Resistance Thermometer Instruments)

Resistance box ranges:— ohms x 100, x 10, x 1, x 0.1, x 0.01.

INSULATION TESTER

An insulation tester capable of indicating an insulation resistance of 20 Megohms at 500V, e.g. Evershed & Vignoles 500V Megger.

TOOLS & ACCESSORIES

Plug and Socket Extension Adaptor — see **SPARES LIST,** page 74
Open Ended and Box Spanners 2BA to 8BA
Desoldering tool
Spare Range Card
Soldering Iron — 15 watt. pencil type (3/32" copper bit)
Small pair of long-nosed pliers
Circlip pliers
Allen Keys 6BA and 8BA hex.
Gramme Gauge — 0 to 30 g.
Pozidriv screwdriver
Cam setting probe
Small screwdriver
Genklene (made by I C I Limited)
Camel-hair Brush
Reel of 22 swg (0.7mm) 60/40 Resin cored solder
T/C or R/T Reference Tables to B.S. specifications.

General

The fault finding procedure is based on sub-unit replacement (e.g. printed circuit assemblies) in the event of failure.

Refer to the **SPARES LIST,** pages 74 and 75 for part numbers of replacement sub-units. Carry out the tests detailed on the following pages in the order shown.

Test figures specified are typical values as measured by an Avometer and the degree of accuracy and influence of the measuring instruments employed should always be taken into consideration when carrying out tests.

When making voltage checks extreme care must be taken because of the presence of MAINS VOLTAGE. The use of properly insulated probes is recommended – do not use crocodile clips.

The mains supply should be disconnected when carrying out insulation, continuity or resistance checks, and before removing or inserting a sub-assembly, wire link connection or components.

Mechanical assemblies should not be divided beyond the stage described in the dismantling instructions.

MAGNETIC CIRCUITS MUST NOT BE DISTURBED UNDER ANY CIRCUMSTANCES

Before disconnecting any wires note their colour and position.

Avoid the use of excessive heat and mechanical stress when soldering, especially where high stability resistors are concerned. A small pair of long-nosed pliers interposed between the solder connection and the component body acts as a suitable heat shunt.

Never touch a slidewire with your hands as contamination will result. If by accident you do so, wash the slidewire with Genklene, using a camel-hair brush.

Preliminary Checks

Before commencing detailed fault-finding carry out the following preliminary checks.

Mains Connections – see Fig. 11

Check customer mains supply and fuses.

Ensure that the connections to the terminal blocks are made correctly, especially the mains line and neutral connections. For mains supplies of 200V to 220V use 200V tapping. Above 220V use 240V tapping. Connect the mains supply.

Using an Avometer set to the appropriate AC voltage range, determine that the following mains voltages are present on the terminal block:

Terminal block pin			
240V,	200V,	115V,	N
16	15	14	13

This will show that the transformer taps are connected to the terminal block and that the transformer primary is operating correctly. Disconnect the mains supply.

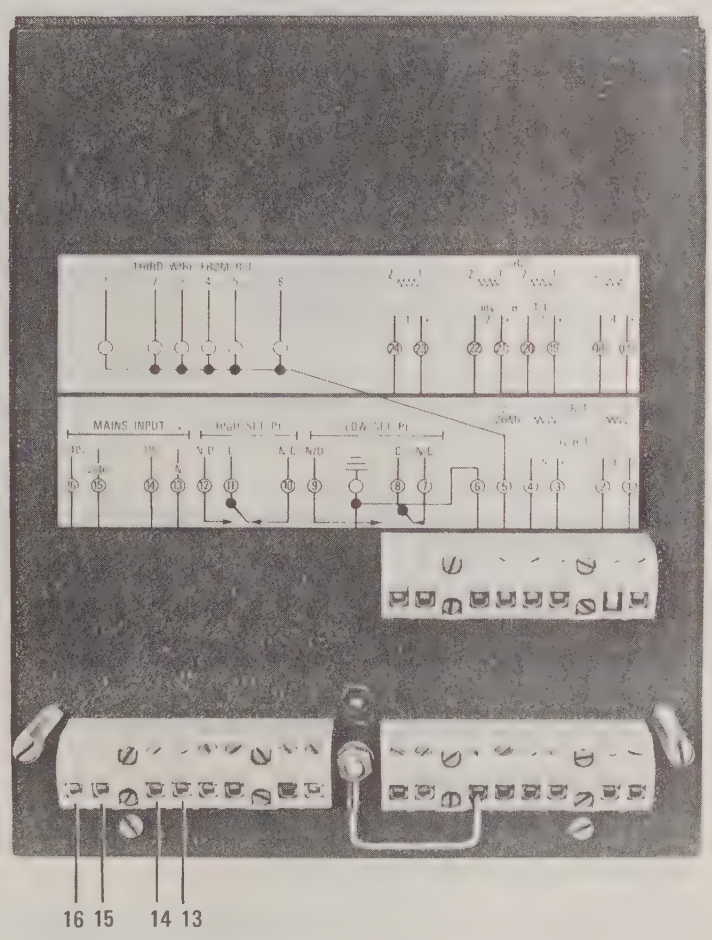


Fig. 11. Terminal Block Connections

Shipping Tie

The linear motor carriage should be tied in place during transit and foam packing placed between the chart unit and door glass.

The tie and any packing present must be removed before the instrument can operate. Access to the recorder may be obtained by pressing the button on the right hand side of the door frame and pulling the door outward. Lift the chart unit disconnecting lever (see Fig. 12). This action unplugs the electrical connection to the chart unit socket, and disengages the chart unit from the main chassis. Tilt the unit forward ready to be lifted out.

The main chassis is retained in its case by a screw through the centre and can be released by rotating the central knob behind the chart unit about ten revolutions anti-clockwise. The main chassis can then be withdrawn completely from its case.

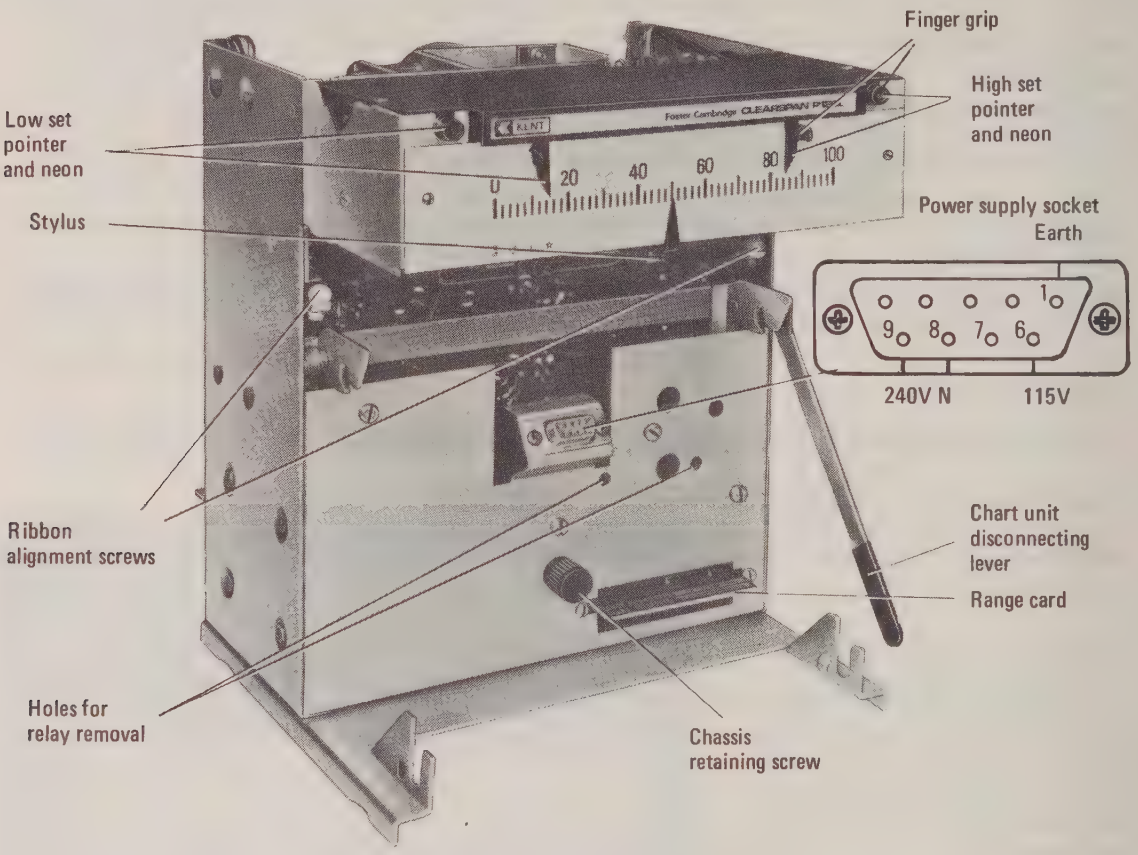


Fig. 12. Main chassis — chart unit removed

Earthing

Remove the terminal block cover on the rear of the instrument case by loosening the two screws at the ends of the cover.

Ensure that an earth link is made between the earth stud and terminal block connection pin 6.

With the chassis withdrawn from the case check for earth continuity, using an Avometer on OHMS ÷ 100 range, between pin 6 on the rear chassis plug and all metal parts of the main chassis excluding printed circuit boards.

Insulation Tests — see Fig. 13

Using a 500 volt Megger, check the insulation resistance between the chassis terminal plug pin 6 and each other terminal plug pin in turn.

The indicated resistance should not be less than 20 Megohms.

Repeat the test on the terminal blocks on the case.

Signal Input

Check that the correct signal source is connected to the terminal block.

Setting Up Procedures

Carry out the appropriate setting up procedures as described on pages 68 to 73.

FAULTS IN THE MAIN POWER SUPPLY AND MEASURING SYSTEM

AC Voltage Levels — see Figs. 13 & 14.

With the P126L removed from its case, connect the extension lead terminal block to the rear of the chassis, ensuring that it is correctly positioned.

WARNING:—

If the 'mains socket' is inadvertently plugged in incorrectly, serious damage to the instrument will result.

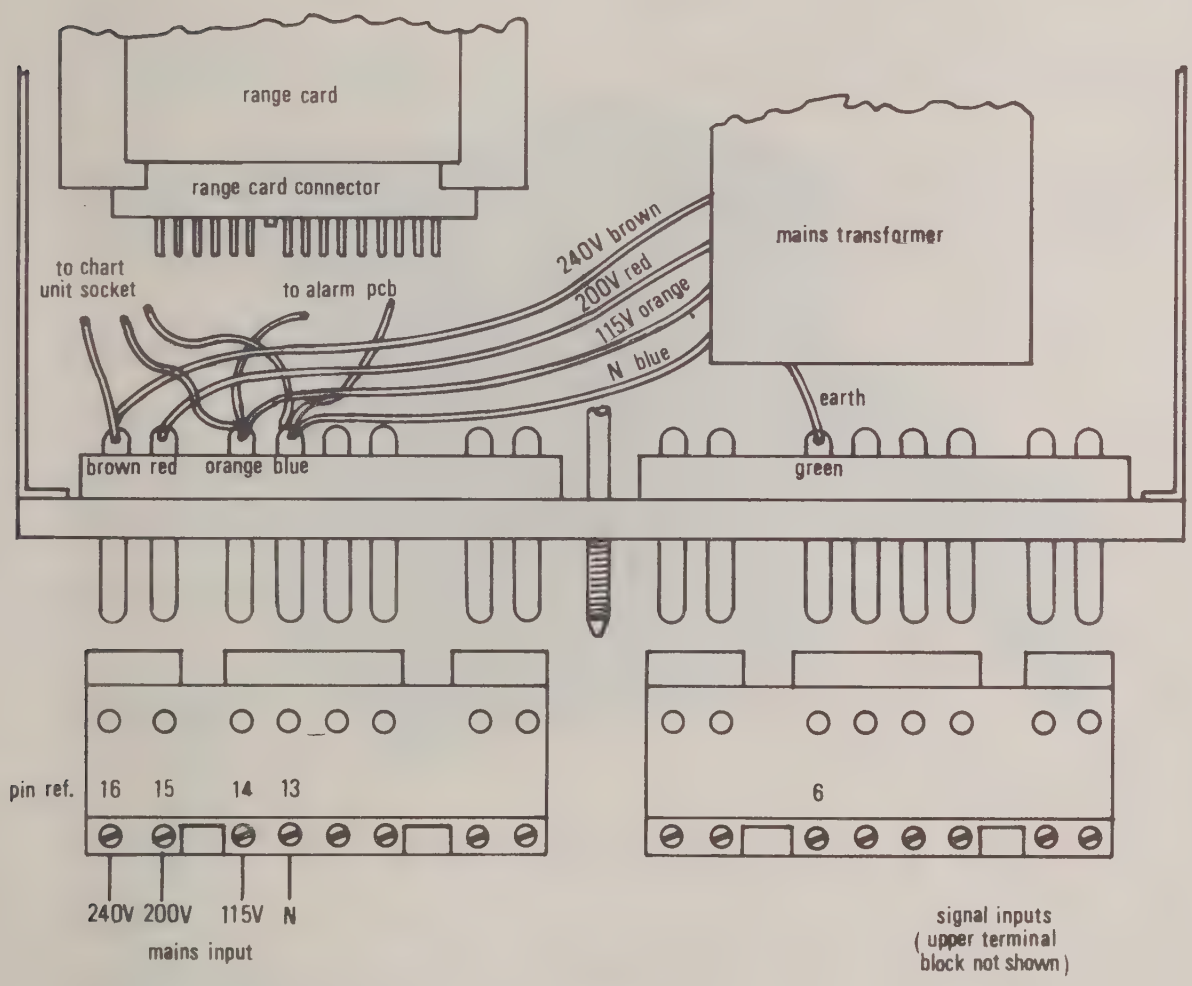


Fig. 13. Main Chassis plug and socket connections.

Connect the mains supply.

Using an Avometer set to the appropriate AC voltage range, determine that the mains voltages 240V, 200V, 115V, referred to N, are present on the extension lead adaptor terminal block.

If the voltages are not present, check the mains supply source, extension lead and terminal block connections.

If the voltages are present additional voltage measurements should be carried out on McMurdo socket pins 9 and 6 referred to pin 8 (Neutral) — see Fig. 12. The measured voltages should be 240V and 115V respectively.

To gain access to the McMurdo socket remove the chart unit by lifting the chart unit disconnecting lever (see Fig. 12) and disengage the chart unit from the main chassis by tilting the unit forward. It is then ready to be lifted out.

AC Secondary Voltage — see Fig. 14.

Using an Avometer set to the 25V AC range, check the secondary voltage on the mains transformer. This should be 11.5V: 0V: 11.5V: (nominal).

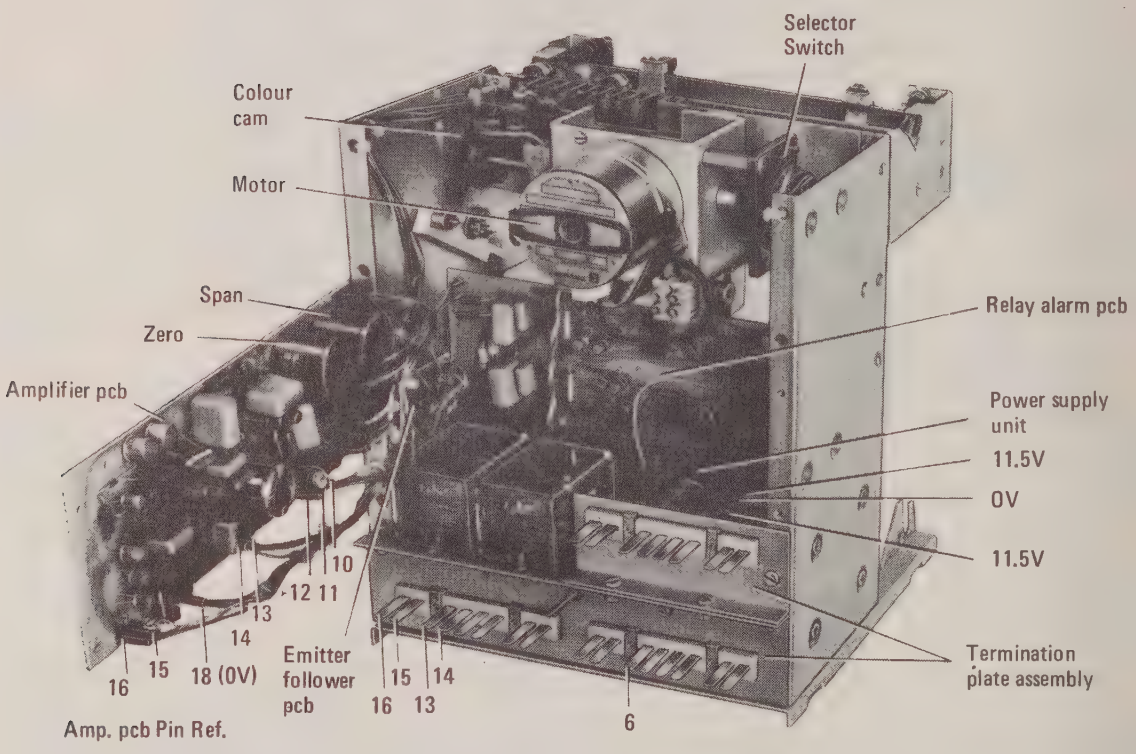


Fig. 14. Interior view of Main Chassis.

If the voltages are not present, disconnect the mains supply (precautionary measure), remove the relays if fitted and carry out a visual check of the transformer primary connections to terminal plug pins 16 (brown) 15 (red) 14 (orange) and 13 (blue).

If no wiring fault is found, replace the power supply unit as a whole. Refer to dismantling and re-assembly instructions on page 55.

DC Voltage Levels — see Figs. 14, 15 and 16.

Before monitoring DC voltage levels detach the amplifier pcb from the rear of the chassis by removing four 6 BA screws. Set the Avometer to the 25V DC range, and monitor the voltage across each of the electrolytic capacitors mounted on the mains transformer printed circuit board. The voltage should be matched within 1.5V. Nominal voltage is 15V.

Remove AVO leads and monitor the voltages on amplifier pcb pins 3, 14 and 15 with respect to the OV rail — see Fig. 15 or 16. The nominal measured voltages should be —6.2V, +15V and —15V respectively.

Note: The —6.2V supply is wired to amplifier pcb pin 3 via Range Card connector pin 11.

If an emitter-follower pcb is fitted, monitor the voltages on pins 4 and 2 with respect to pin 3 (OV).

The nominal voltages should be +15V and —15V respectively.

For alarm versions additional voltage measurements should be carried out on alarm pcb pins 16 and 18 with respect to pin 17. The nominal measured voltages should be +15V and —15V respectively.

If the printed circuit board voltages are not present detach the termination plate assembly by removing three 4 BA screws, and detach the power supply unit by removing the four 4 BA nuts securing it to the main chassis. Continuity checks should be carried out between the relay alarm pcb pins referred to above and the power supply unit pins to which they are wired.

If continuity is established change the power supply unit, referring to the dismantling and re-assembly instructions on page 55.

WARNING

ON NO ACCOUNT SHOULD THE MAINS SUPPLY BE SWITCHED ON WITH THE —6.2V SUPPLY LEAD DISCONNECTED FROM AMPLIFIER PRINTED CIRCUIT BOARD PIN 3 OR 0 VOLTS FROM PIN 11.

DAMAGE TO THE VOLTAGE STABILIZING CIRCUIT WILL RESULT.

Linear Motor Voltages — see Fig. 17.

The voltage applied to the linear motor coil varies between +11V and —11V, approaching zero when the measuring system is at balance.

With the correct DC voltages present at the amplifier pcb pins 3, 14 and 15, monitor the linear motor voltage between amplifier pcb pins 5 and 16 whilst moving the linear motor carriage manually. If the linear motor voltage is not present change the amplifier pcb — see page 56.

If the voltage is present at pins 5 and 16, repeat the test with the Avometer connected to fanning strip pins 7 and 8. Check for continuity between the fanning strip and amplifier pcb if necessary.

Finally, check the continuity of the linear motor coil at the coil leadouts — should be approximately 68 ohms. If faulty, change the linear motor assembly — see page 52. If correct, change the umbilical cord — see page 54.

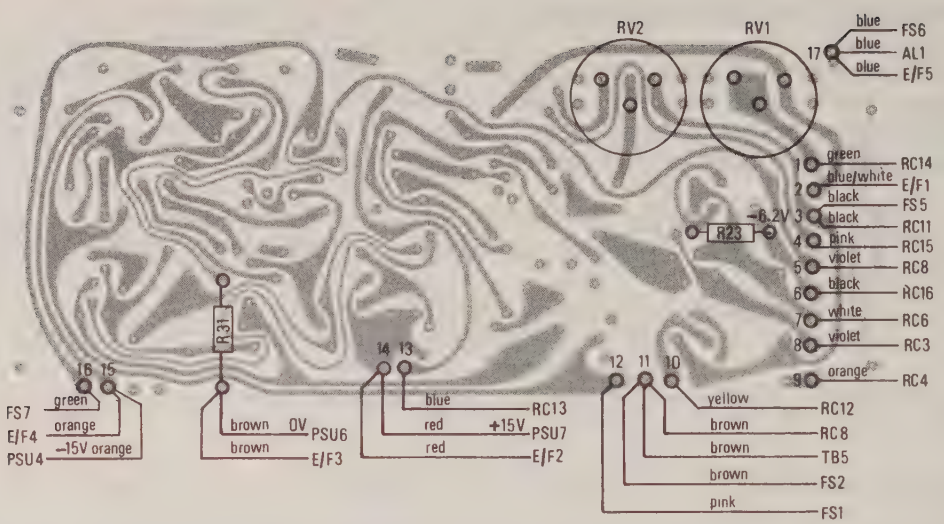


Fig. 15. Amplifier PCB P126L – 01 – 0058 Component Side

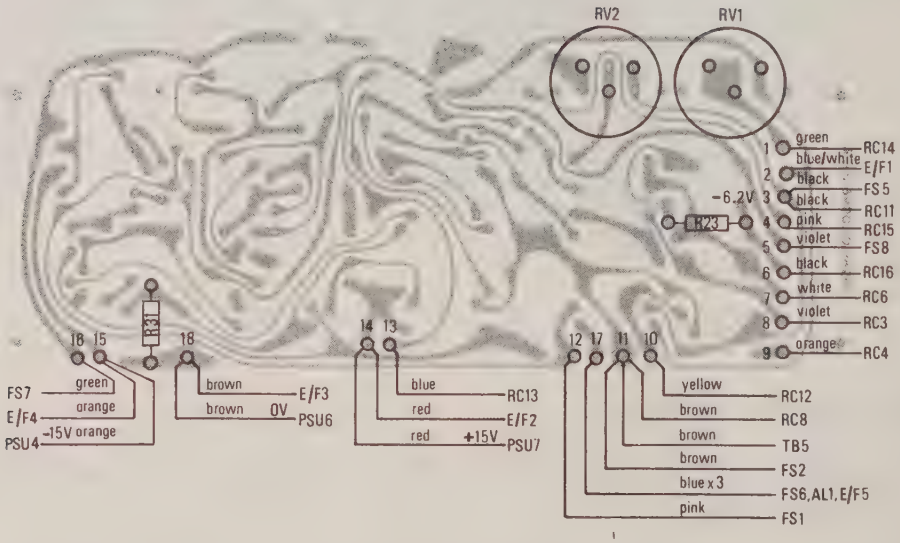


Fig. 16. Amplifier PCB P126L – 01 – 0086 & – 0095 Component Side

FAULTS IN THE LINEAR MOTOR SLIDEWIRE SYSTEM

Ensure that the indicating pointer is not touching the bottom of the scale and that there is no undue stiction when gently moving the linear motor assembly up and downscale manually.

Remove the motor assembly cover and check the following voltages within the linear motor assembly.

Slidewire Voltage — see Figs. 17 and 18

With the mains connected and using an Avometer on DC volts range, 'touch' the slidewire OV terminal pin (black wire attached) with the positive probe of the Avometer and the –6.2V terminal pin with the negative probe. The measured voltage should be –6.2V ± 0.3V. DO NOT USE CROCODILE CLIPS OR PINCLIPS TO CONNECT THE AVOMETER LEADS. Such attachments may sever the very fine wire soldered to the terminal pins.

If the slidewire voltage is not present, make a visual check of wire connections to pins 18, 11 & 3 on the amplifier printed circuit board and pin 11 on the range card connector.

If the slidewire voltage is incorrect carry out the following subsidiary checks before changing the power supply unit.

Disconnect the mains supply.

Carry out the following continuity/resistance checks with the Avometer, set to OHMS X1 range, connected between the following positions:

(a) Slidewire OV terminal pin (black wire attached) and Fanning strip pin 2 should be zero ohms.

(b) Slidewire –6.2V terminal pin (violet wire attached) and Fanning strip pin 5 should be zero ohms.

(c) Fanning strip pin 5 and amplifier printed circuit board pin 5. Should be zero ohms.

(d) Fanning strip pin 2 and amplifier printed circuit board pin 11. Should be zero ohms.

(e) Slidewire termination pins. The measured resistance should be approximately 1000 ohms. Replace slidewire if necessary. Refer to page 54.

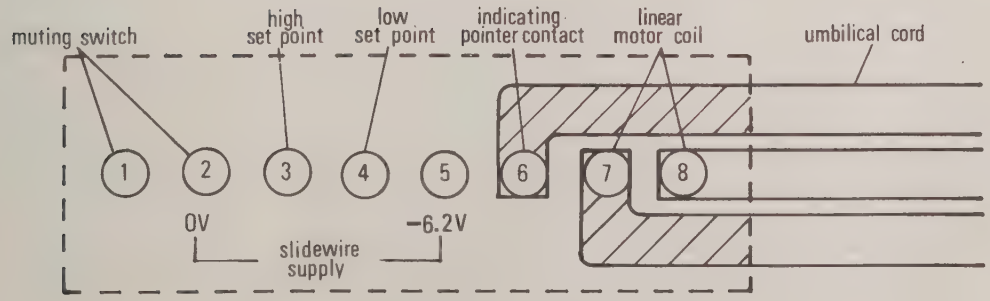


Fig. 17. Fanning Strip Connections

Indicating Pointer Contact Voltage — see Fig. 18.

With the mains supply connected and the Avometer set to 25V DC range, connect the negative probe of the Avometer to the indicating pointer contact. Touch the OV slidewire terminal pin with the positive probe. The measured voltage should be proportional to the position of the indicating pointer contact along the slidewire, between 0V and 6.2V.

If the indicating pointer contact voltage is not present, check the contact between the brush attached to the linear motor carriage and the slidewire. The nominal working pressure between the brush contact spring and slidewire is between 25 and 30 grammes, this is factory set. A dirty slidewire or contact should be cleaned as detailed on page 54.

If the contact is faulty, replace it in accordance with the instructions on page 57.

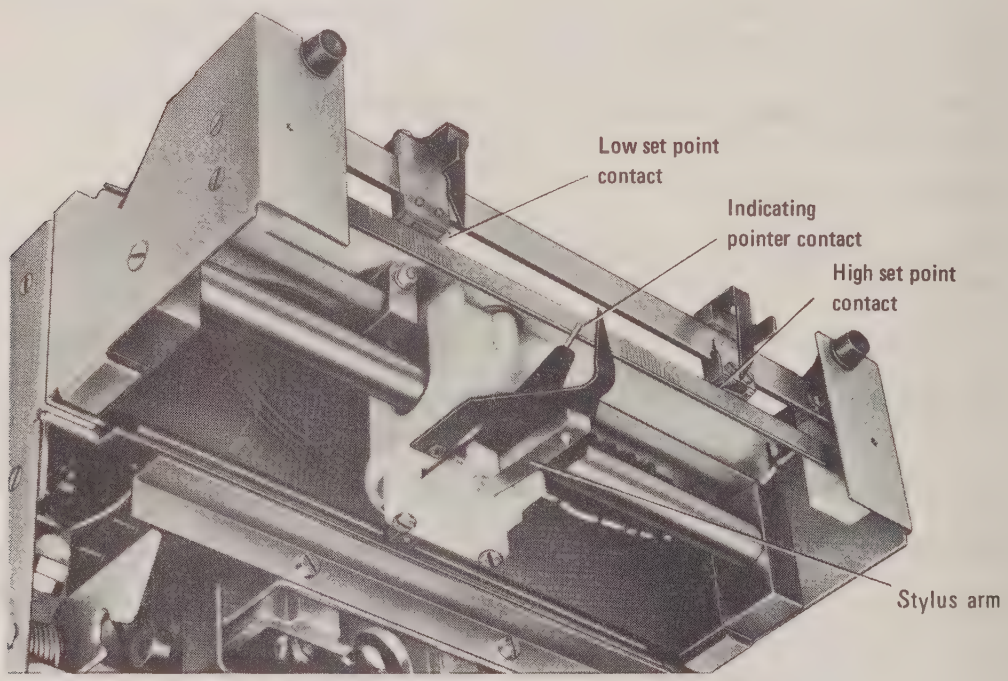


Fig. 18. Linear Motor Assembly

In the case of instruments manufactured prior to mid – 1974 the brush contact may be adjusted by rotating the set screw in the recess beneath the linear motor.

To obtain access to the set screw, detach the stylus arm by removing the two 8BA screws, position the linear motor at mid - scale immediately above the access hole in the lower section of the linear motor chassis. The nominal working pressure between the contact and slidewire should be between 25 and 30 grammes.

A dirty slidewire or contact should be cleaned as detailed on page 54. If the brush contact spring is faulty it is recommended that an exchange linear motor is fitted as the dismantling/re-assembly procedure is rather complicated and should only be carried out by a skilled instrument technician.

If the voltage is present at the indicating pointer contact and OV terminal pin, the differential voltage may also be checked at the following locations:

Fanning strip pin 6 (–ve) and pin 2 (+ve)
Amplifier printed circuit board pin 17 (–ve) and pin 11 (+ve).

If the voltage is not present at these locations, disconnect the mains supply and carry out continuity checks from the linear motor assembly to the amplifier printed circuit board. Repair or replace interconnections as necessary.

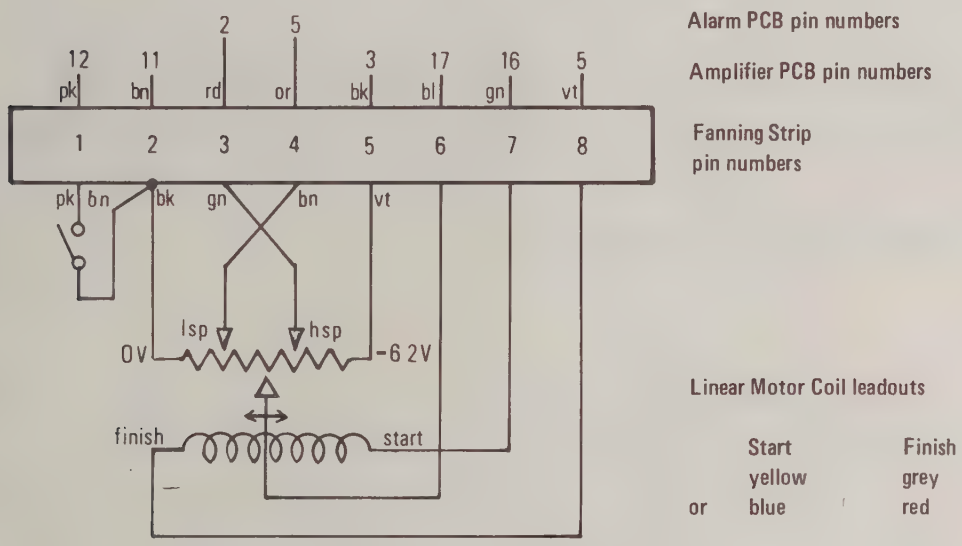


Fig. 19. Linear Motor Inter-connections

FAULTS IN INPUT RANGING CIRCUITS – see Figs. 15, 16 & 20

Carry out the setting up procedure as described on pages 68 to 70. If the recorder cannot be calibrated successfully, proceed with the following tests:

Connect the mains supply and monitor the DC voltages between the pins detailed below. The measured values should be as specified.

Amp. PCB	Pin 11 and pin 3	–6.2V ± 0.3V.
Range Card	Pin 8 and pin 11	–6.2V ± 0.3V.

Refer to pages 20 and 21 if voltage incorrect.

Thermocouple input only:

Amp. PCB	Pin 11 and pin 9 (ACJC)	–0.6V ± 0.03V
Range Card	Pin 8 and pin 4	–0.6V ± 0.03V

Refer to **ACJC Transistor** page 28 if voltage incorrect.

Locate the three pins to which the zero potentiometer (RV2) is connected. Connect the positive lead of the Avometer to one end of the potentiometer, negative lead to the wiper. Note the voltage.

Connect the positive lead to the wiper, negative lead to the other end of the potentiometer. Again note the voltage. The sum of the two readings obtained should be –6.2V ± 0.3V.

If either of the two voltage readings is zero, rotate RV2 over its full traverse. The voltage should vary continuously between approximately 0 volts and –6.2V.

Reset RV2 approximately to its original position.

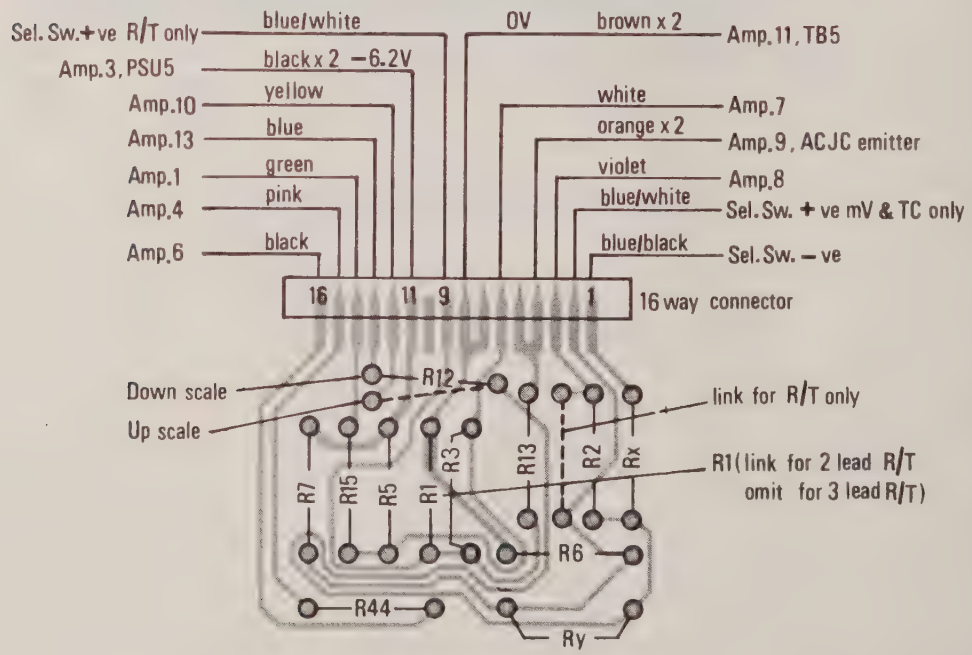


Fig. 20. Connections to Range Card

Disconnect the mains supply. Withdraw the range card from its 16-way connector, and replace with a spare range card of the same or similar range. Reconnect the mains supply and check instrument operation. If the fault still exists disconnect the mains supply, withdraw the range card and carry out the following tests.

Set the Avometer to OHMS x 1 range and connect the meter across span potentiometer RV1. Note the resistance reading. Rotate RV1 over its full traverse. The resistance reading should vary between zero ohms and approximately 47k ohms. Reset RV1 to approximately its original position.

If the fault does not lie in the zero or span potentiometers, insert the spare range card. Disconnect the selector switch wiper link wires from their turret lugs. Connect a Foster Cambridge portable potentiometer (for mV or TC inputs) OR a resistance box (for R/T inputs) between the turret lugs. Switch on the mains supply, refer to BS specification tables and inject a signal equivalent to each of the normal mV or TC signal input levels OR set the resistance box to the value appropriate to each of the R/T temperature levels.

If the indication is correct at each simulated temperature, check for continuity between main terminal block and selector switch and for correct alignment of stud contacts on the switch. Repair inter-wiring or re-align stud contacts as necessary. Reconnect switch wiper link wires.

If the indicated temperature is still incorrect, check the DC volts at emitter follower pcb pins 2 and 4 with respect to pin 3 (OV). The measured voltage should be +15V and −15V respectively. Disconnect the wires from E/F pcb pins 1 and 5 and connect these two wires together. If the instrument now indicates correctly replace the emitter follower pcb — see page 57.

If the instrument still indicates incorrectly change the amplifier pcb — see page 56.

If the instrument works satisfactorily when the spare range card is fitted, resistance checks may be carried out on the following resistors of the faulty range card. R1, R2, R3, R5, R6, R7, R13, R15 and R44. If necessary disconnect one end of the resistor to avoid parallel connection. Range card layout is shown in Fig. 20.

Examples of temperature and millivolt ranges and typical values of associated ranging resistors, are shown in the table below.

	Range	BS No. and DIN Spec.	Resistance in ohms								
			R1	R2	R3	R5	R6	R7	R13	R15	R44
Thermocouple	0–200°C	Type 'K' BS 4937 pt 4 DIN 43710	169	1k	27.4	OMIT	56.2	22.1k	8.25k	110k	LINK
	0–1000°C	Type 'K' BS 4937 pt 4 DIN 43710	169	1k	825	OMIT	88.7	22.1k	8.25k	110k	22.1k
	0–1600°C	Type 'R' BS 4937 pt 2 DIN 43710	23.7	1k	365	OMIT	24.9	22.1k	8.25k	110k	LINK
Linear Voltage	0–10mV	———	LINK	1k	237	OMIT	10.0	22.1k	OMIT	110k	LINK
	0–100mV	———	LINK	1k	2.21k	OMIT	88.7	22.1k	OMIT	110k	68.1k
Resistance Thermometer	0–100°C	BS 1904 DIN 43760	*	402	287	12.1k	OMIT	12.1k	OMIT	110k	LINK
	0–250°C	BS 1904 DIN 43760	*	392	464	30.1k	OMIT	30.1k	OMIT	110k	LINK
	0–408°C	BS 1904 DIN 43760	*	274	340	61.9k	OMIT	61.9k	OMIT	110k	LINK

* Link for 2 lead R/T
Omit for 3 lead R/T

ACJC Transistor — see Fig. 21

If the compensating transistor is short circuited the indicating pointer will be deflected up scale. Conversely, if the transistor is open circuit the indicating pointer will be deflected down scale.

Monitor the DC voltage on the amplifier printed circuit board pins 9 and 11. This should be −0.6V ±0.03V. If the voltage is still incorrect change the amplifier printed circuit board.

If the instrument operates correctly but the temperature compensation is suspected, check that R13 (Fig. 20) and R14 (Fig. 21) are not faulty. The resistance values should be 8.25k ohms and 2.74k ohms respectively. Change the compensating transistor if R13 and R14 are correct.

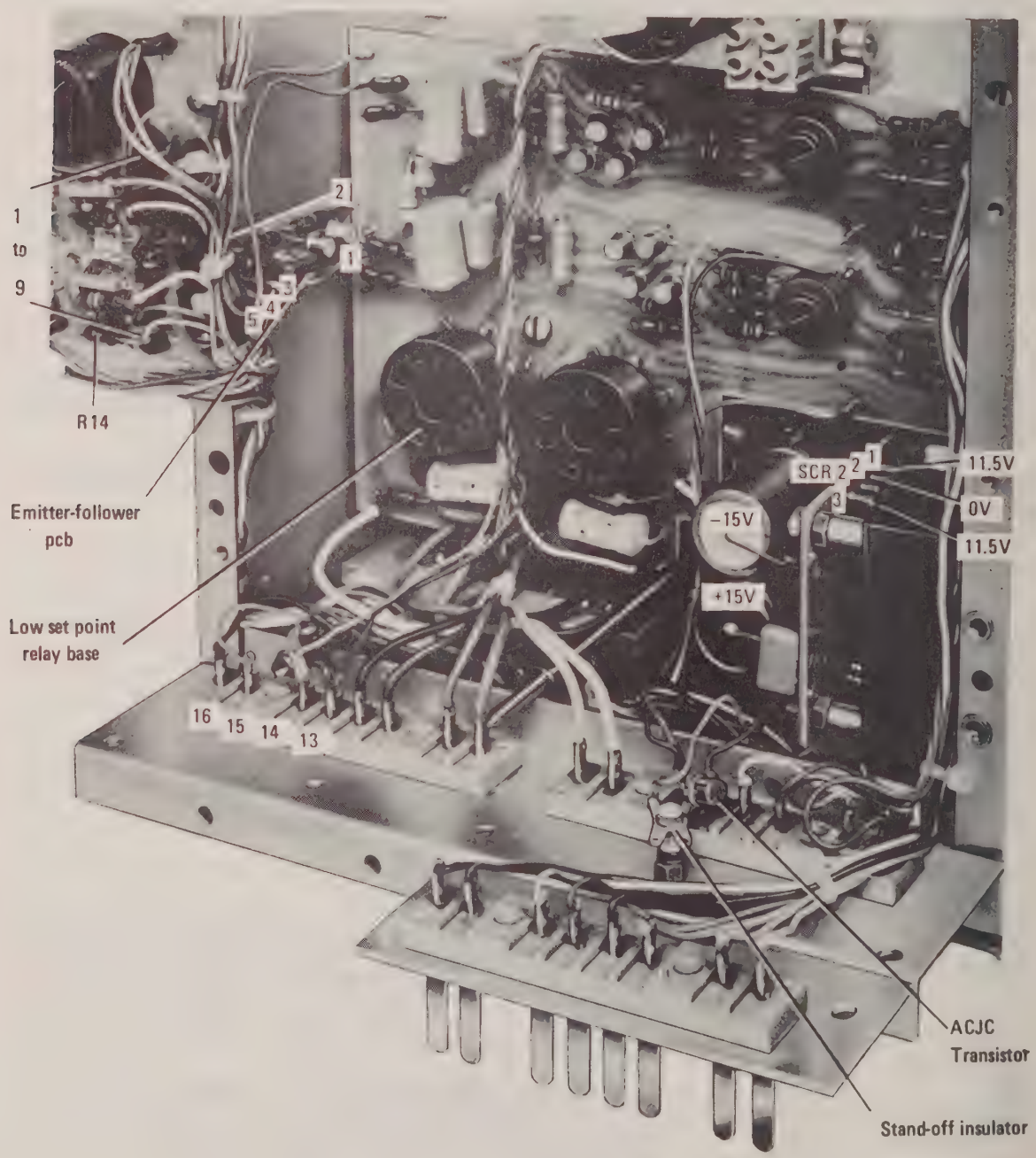


Fig. 21. ACJC Transistor

Fig. 22. 6 Point Recorder Wiring Diagram – T/E, mV input only

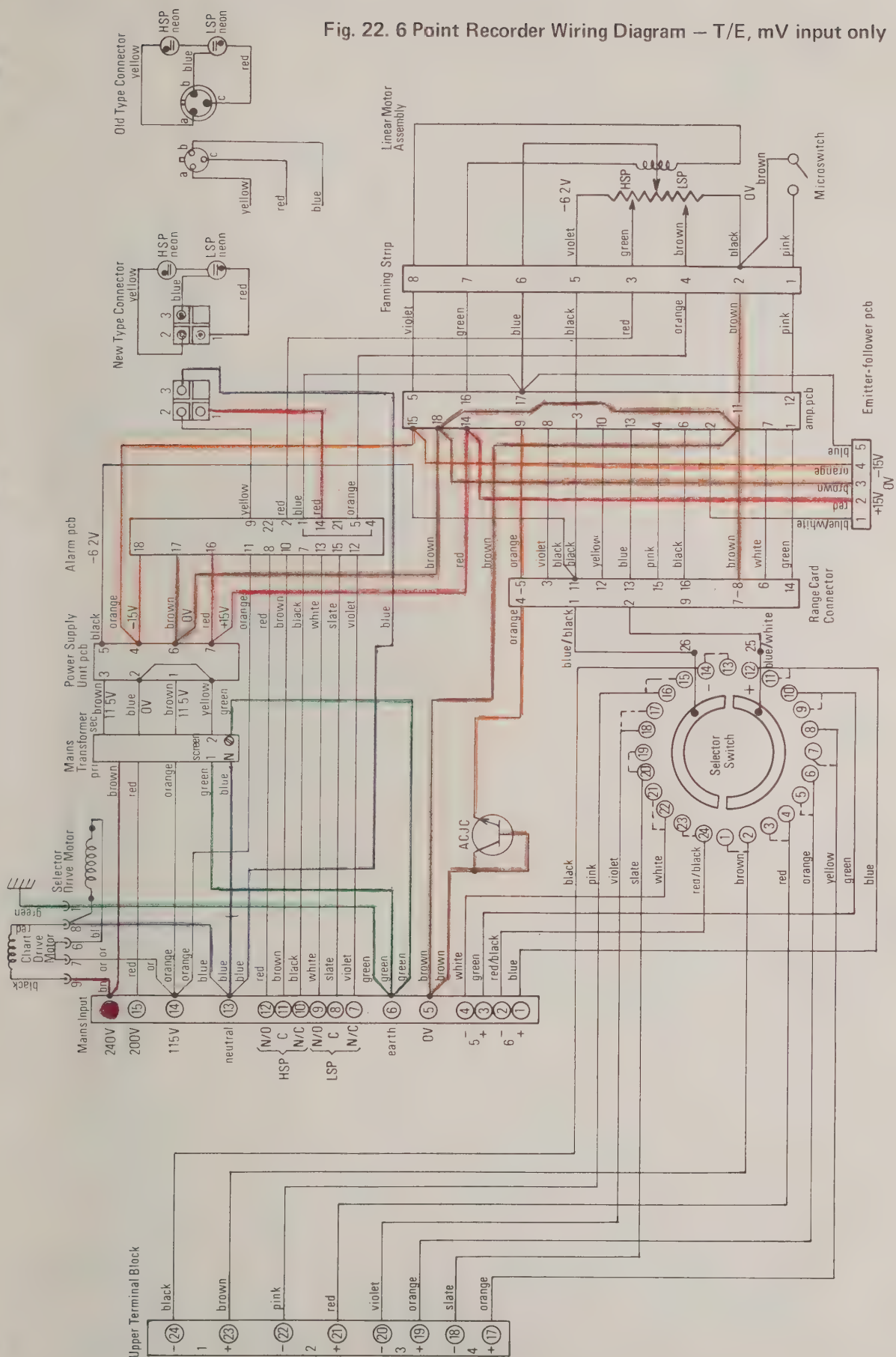
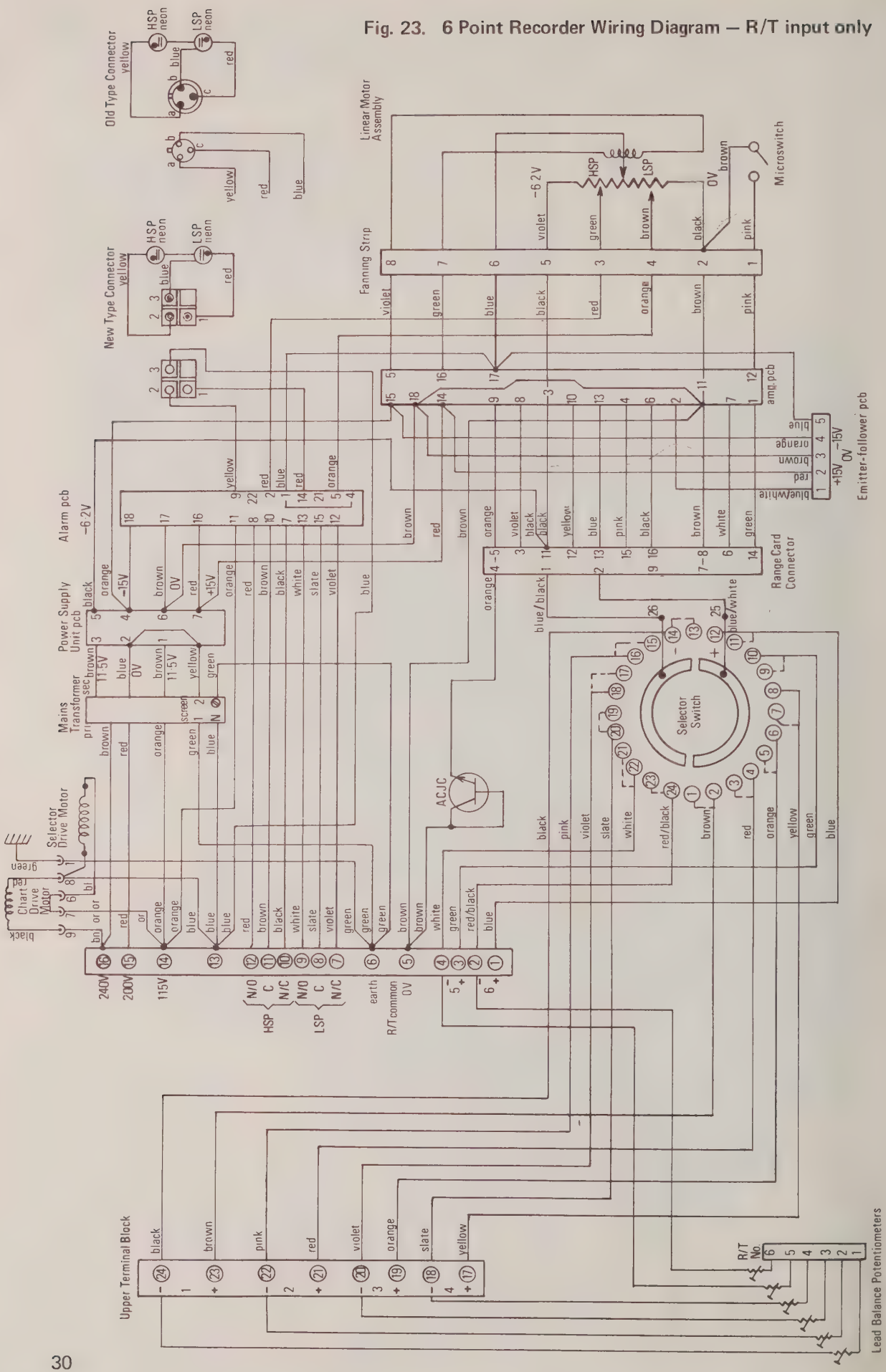


Fig. 23. 6 Point Recorder Wiring Diagram — R/T input only



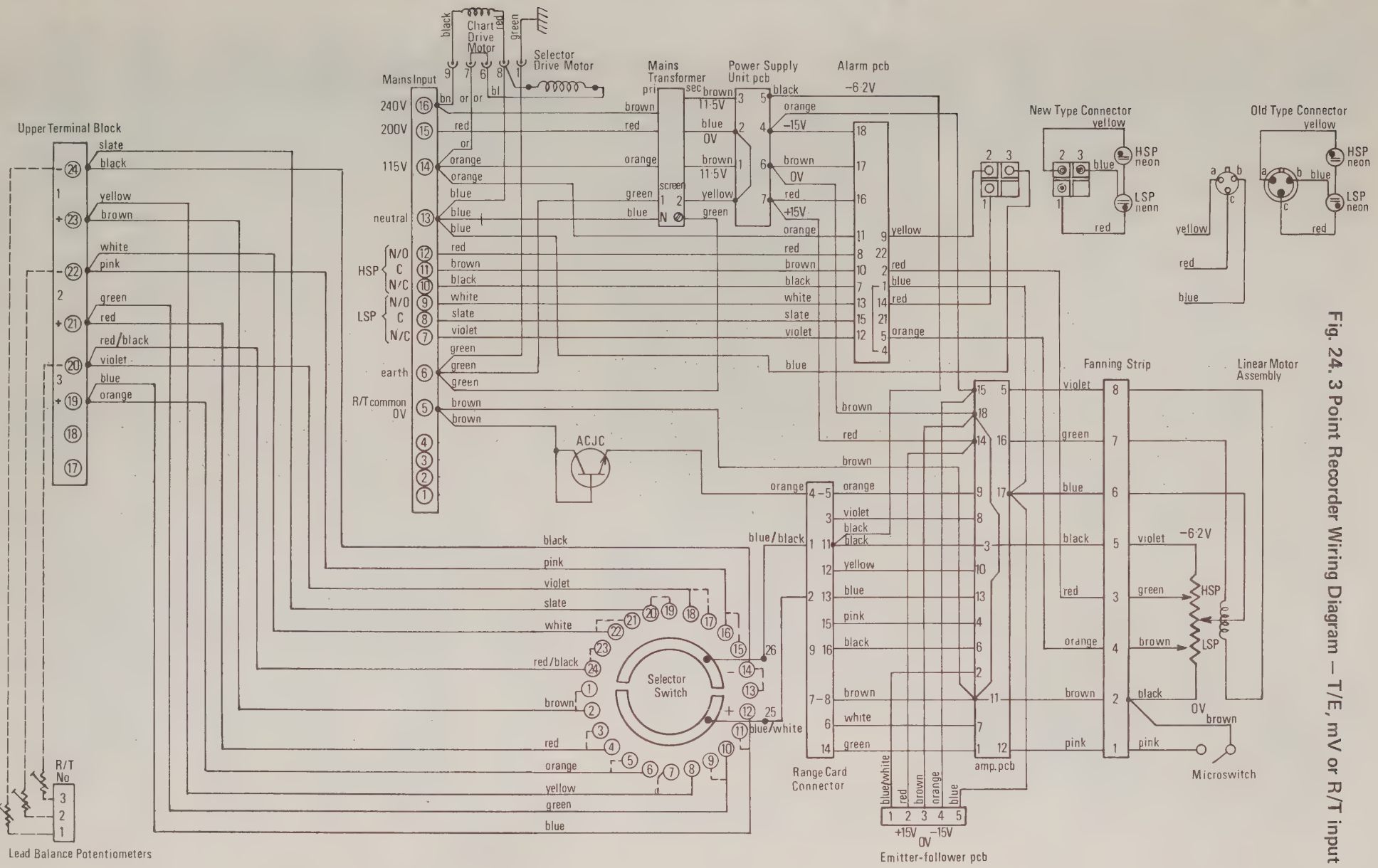


Fig. 24. 3 Point Recorder Wiring Diagram – T/E, mV or R/T input

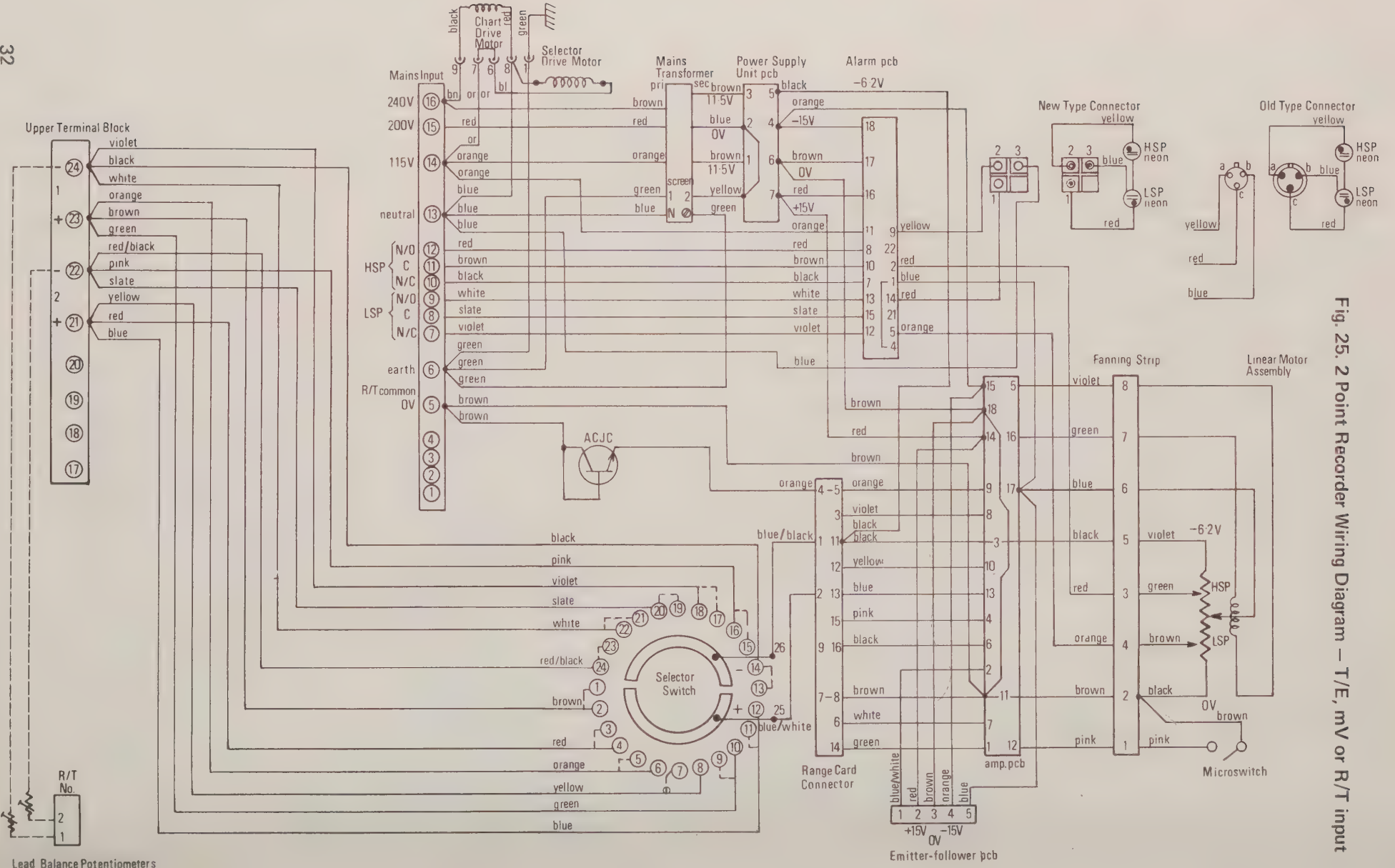


Fig. 25. 2 Point Recorder Wiring Diagram — T/E, mV or R/T input

Arc suppression components — see Fig. 26

Capacitors C104 and C204 across the N/C relay contacts have a value of 0.01 microfarads. The N/C contacts are normally used for switching alarm circuits.

Capacitors C105 and C205 across the N/O relay contacts are each 0.1 microfarads and are fitted to reduce contact burning when switching highly inductive loads.

However, if an intermediate relay is incorporated in an inductive switching circuit, capacity current through the 0.1 microfarad capacitor may cause the intermediate relay to hold in. In this event C105 (or C205) should be changed to 0.01 microfarads or the N/C contacts may be used.

Later instruments may have a 0.01 microfarad capacitor in parallel with each 0.1 microfarad capacitor so that the 0.1 microfarad capacitor, usually yellow in colour, need only be removed (with cutters).

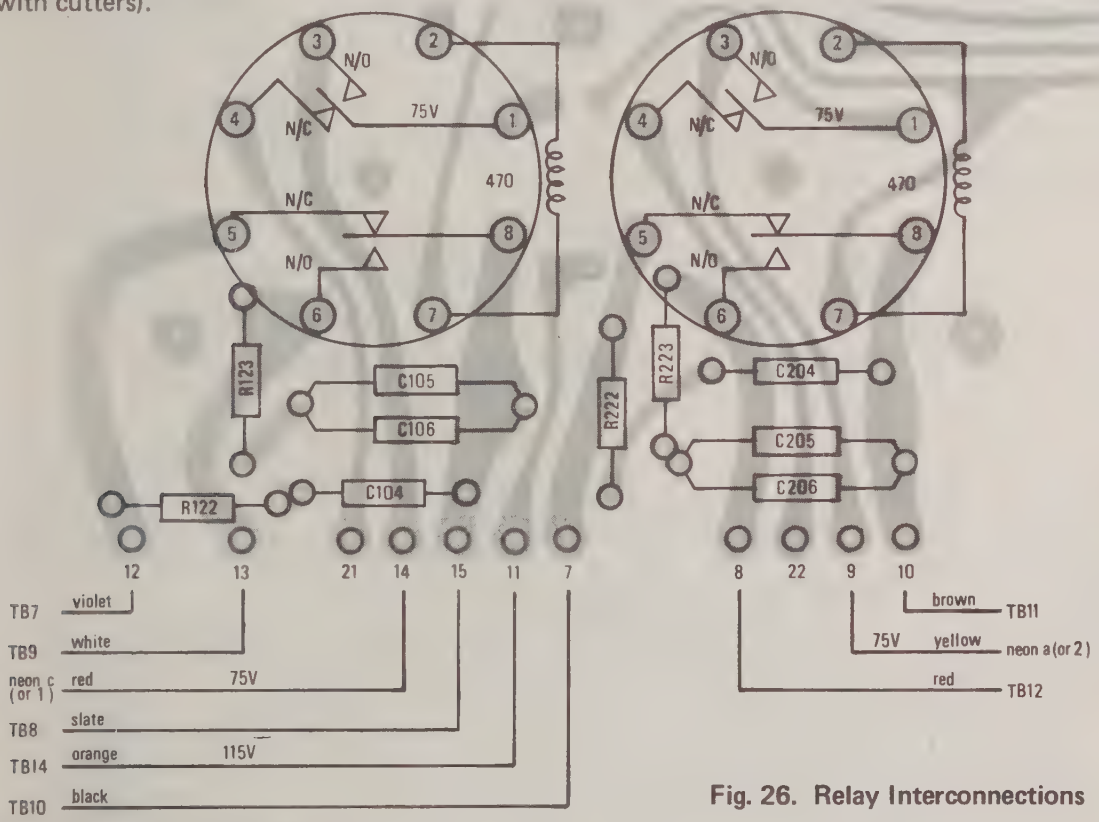


Fig. 26. Relay Interconnections

Relay Operating Voltage — see Fig. 26.

Remove the chart unit by lifting the chart unit disconnecting lever — see Fig. 12. This action disengages the chart unit from the main chassis and the unit will tilt forward ready to be lifted out. Unplug the relays from their respective sockets by pushing a screwdriver through the holes in the chassis behind the chart unit.

Set the Avometer to 25V DC range, connect a 470 ohm resistor between the Avometer terminals, to simulate relay loading and connect the AVO leads to the following pins on each relay socket.

Positive	Negative lead
Pin 7	Pin 2

Exerting light pressure on the linear motor coil move the carriage manually along the full length of the slidewire and check that the voltage switches between OV and approximately 25V.

If the voltage is not present carry out a DC voltage check on relay alarm pcb pins 16 and 18 with respect to pin 17 (0 volts). The measured voltages should be nominally +15V and −15V respectively. **DC Voltage Levels**, page 21, refers.

Set Point Contacts — see Fig. 27

A differential voltage test should be carried out between the indicating pointer contact and the set pointer contact.

Check the following voltages, making certain that set point contacts are correctly positioned on the slidewire. Remember that the total voltage across the slidewire is 6.2V and the measured voltage will be proportional to the position of the high or low set pointer.

Positive lead	Negative lead
Amplifier board pin 17	Alarm board pin 2 (High set point)
Alarm board pin 5	Amplifier board pin 17 (Low set point)
Slidewire OV terminal pin	Set point contacts taken in turn
Fanning strip pin 6	Fanning strip pin 3 (High set point)
Fanning strip pin 4	Fanning strip pin 6 (Low set point)

If the correct voltages are not present or are intermittent, clean or change the slidewire (see page 54) or repair the interwiring.

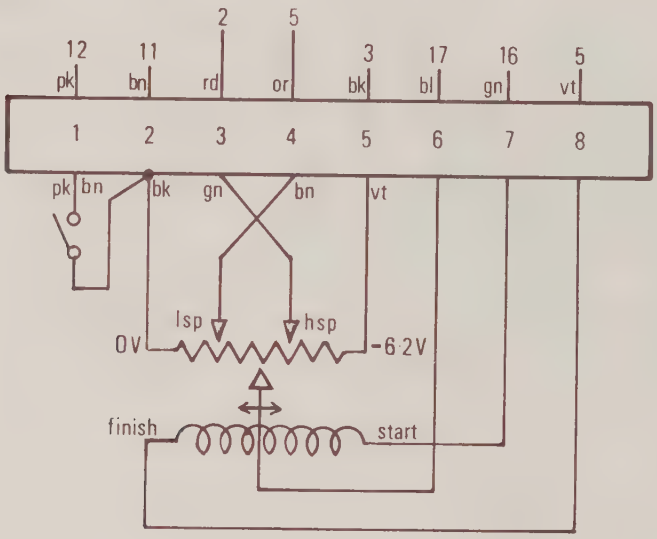


Fig. 27. Linear Motor Inter-connections

Neon Supply Voltage — see Fig. 26

Drive the linear motor carriage up and down scale to check that the relays are operating.

If a neon fails to operate when the indicating pointer passes the set pointer, check for 75V AC at the appropriate neon indicator whilst moving the linear motor carriage manually past the set point. If voltage is present change the neon, if not present check for 115V at terminal block pins 13 (Neutral) and 14 (115V) and between neutral and relay board pin 11 (115V). If necessary repair interwiring between terminal block, relay board and neon indicator.

Remove the relays, check for 75V between neutral line and pin 1 on appropriate relay socket. Insert the relays and check for 75V between neutral line and relay board pin 9 for High Set Point, pin 14 for Low Set Point. If not present change the relay board.

Check for 75V between neon socket pins b (or 3) and a (or 2) for High Set Point or pins b (or 3) and c (or 1) for Low Set Point. If necessary repair the interwiring.

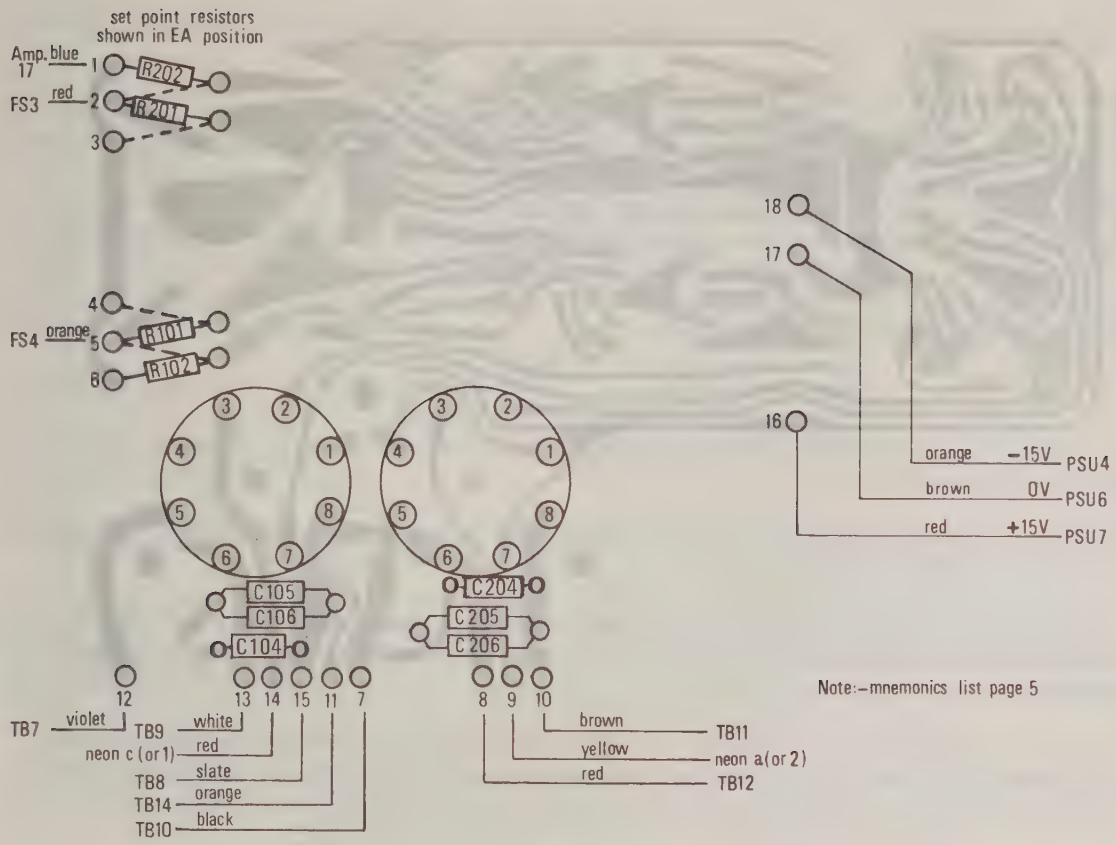


Fig. 28. Relay Alarm pcb. Type P126L - 01 - 0053

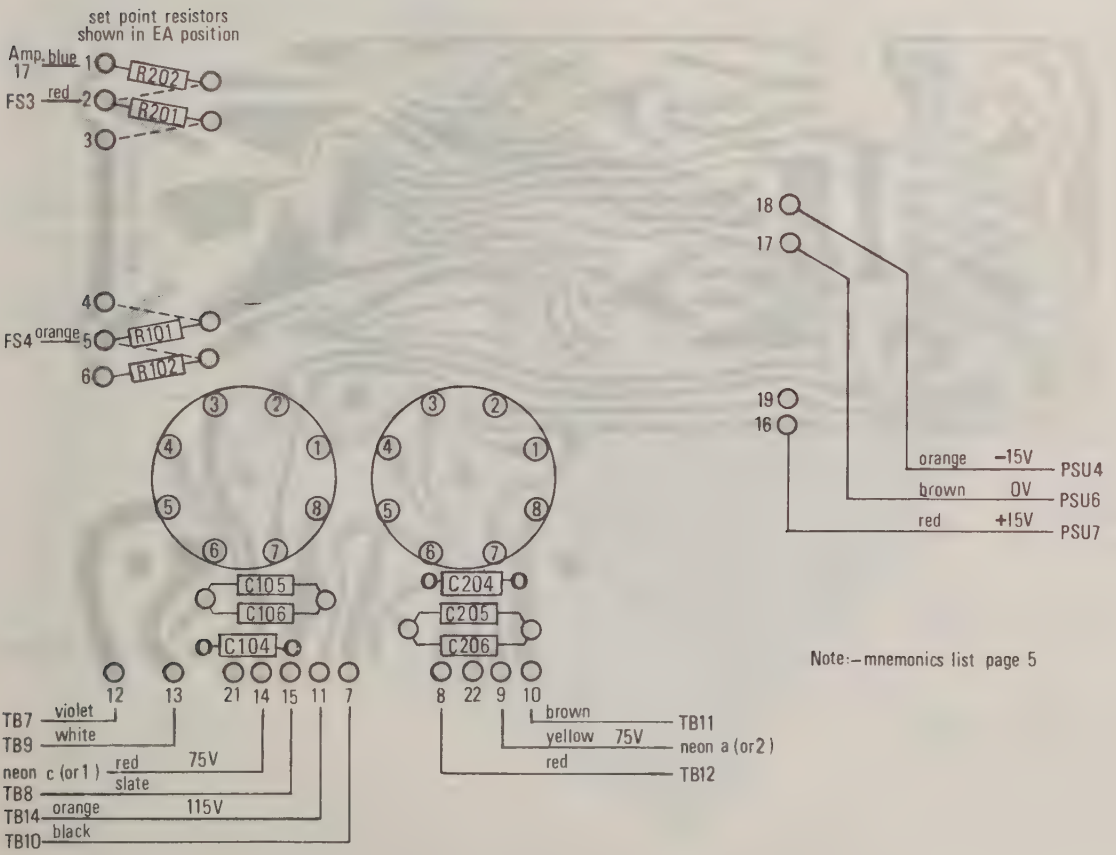


Fig. 29. Relay Alarm pcb. P126L - 01 - 0080

FAULTS IN THE CHART UNIT AND SELECTOR DRIVE SYSTEMS

Chart Drive

If the chart is not driving, remove the chart unit and check for 240V AC between pins 8 and 9 at the McMurdo socket on the main chassis – see Fig. 12.

If the voltage is not present there is a wiring fault between the socket and main terminal block – see Fig. 12.

Carry out a visual continuity check between:

McMurdo socket		Main Terminal Block
pin 8	and	pin 13
pin 9	and	pin 16

Repair wiring as necessary.

If the voltage is correct the fault lies between the McMurdo plug on the chart unit and the chart drive motor or within the motor itself.

Carry out a visual/continuity check of the wiring between plug and motor. If no fault is found check that the face cam is not slipping on the drive shaft – tighten the two 6 BA grub screws if necessary.

To check that the gear train moves freely when turned by hand, remove the drive motor – see page 58 and Fig. 43. Also check that the chart moves on when the serrated flange on the take up roller is rotated.

If the above conditions are satisfied the drive motor should be replaced.

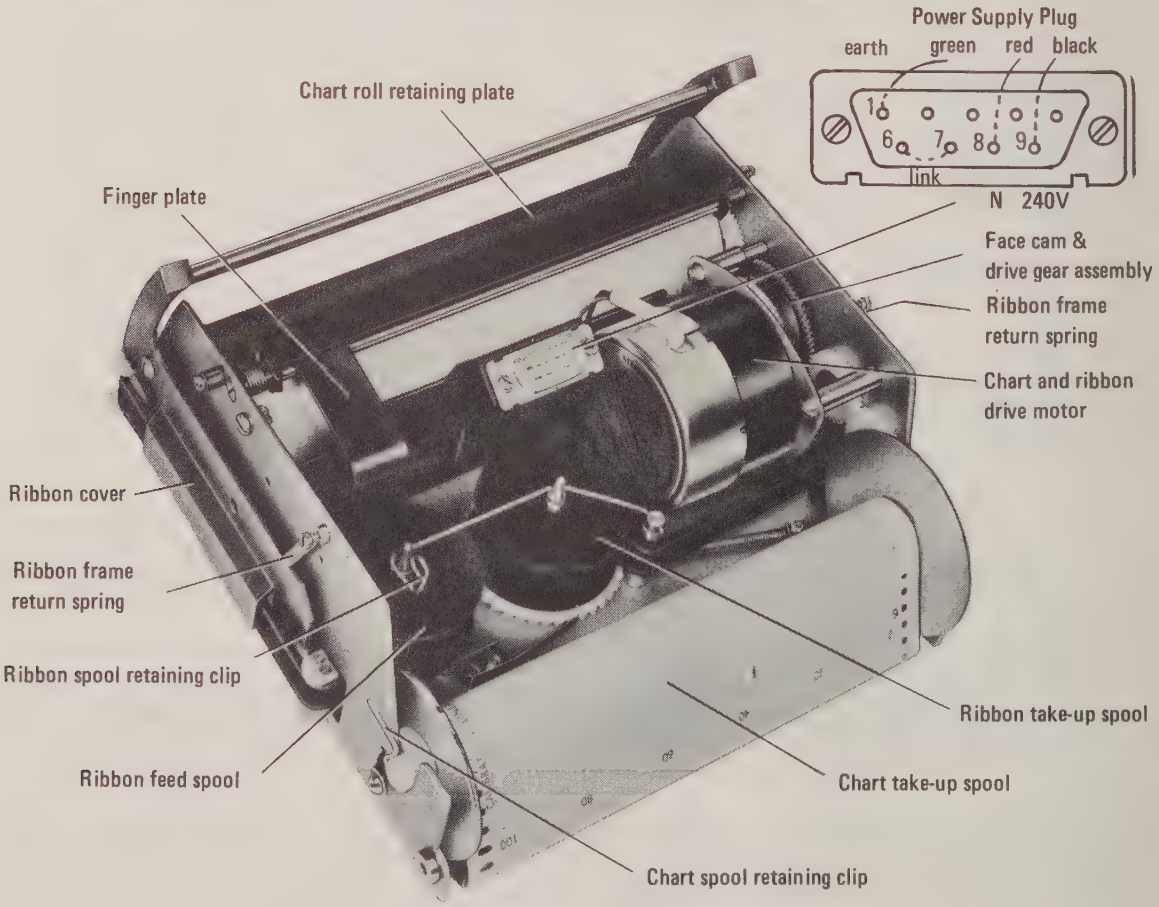


Fig. 30. Chart Unit Assembly.

Take-Up Clutch Adjustment — Fig. 32

The factory setting of the take-up clutch is 90 gcm (1.3 ounce inches) and is optional for the full range of chart speeds and environmental conditions. If the chart is not re-winding, the clutch may be adjusted but before making any adjustments check the drive to the take-up spool for damage. A bent flange or tight bearings resulting from accidental dropping are the most likely sources of trouble. Remove the take-up spool from the chart cassette and slide the chart off the spool. Undo the three countersunk screws which attach the spool to the clutch boss. The clutch adjustment is a 2 BA nut which alters the spring pressure on the clutch assembly. Tightening the nut increases the torque transmitted by the clutch. Not more than half a turn of the nut should be made at a time.

Re-assemble and test.

Note that the clutch is lubricated with clock grease during assembly and should not be run dry. Do not use molybdenised grease.

Ribbon Drive. Figs. 31 and 32.

If the ribbon spool is not being driven, remove the chart unit and check the movement of the ratchet lever manually. At the same time, ensure that the ribbon spool non-return spring is engaging in the spool ratchet and the ratchet lever return spring is operative. Mechanical movement to the ratchet lever is produced by the action of the ratchet arm riding along the angled face of the cam.

The cam is positioned on the motor drive shaft where it is secured by two 6 BA grub screws — check for tightness. Loose screws result in loss of drive to ribbon spool and chart.

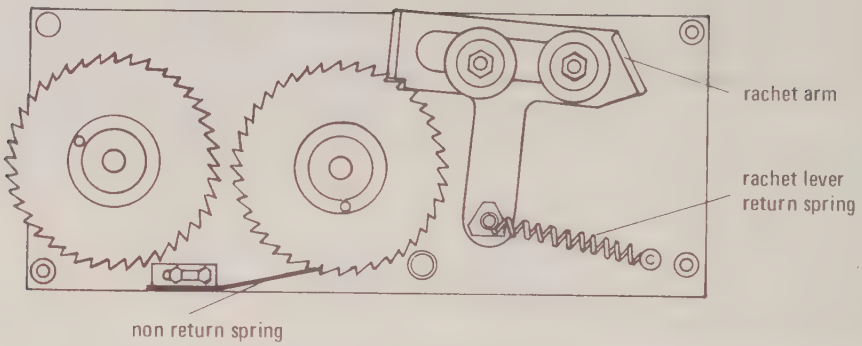


Fig. 31. Chart Unit Sub-frame Assembly.

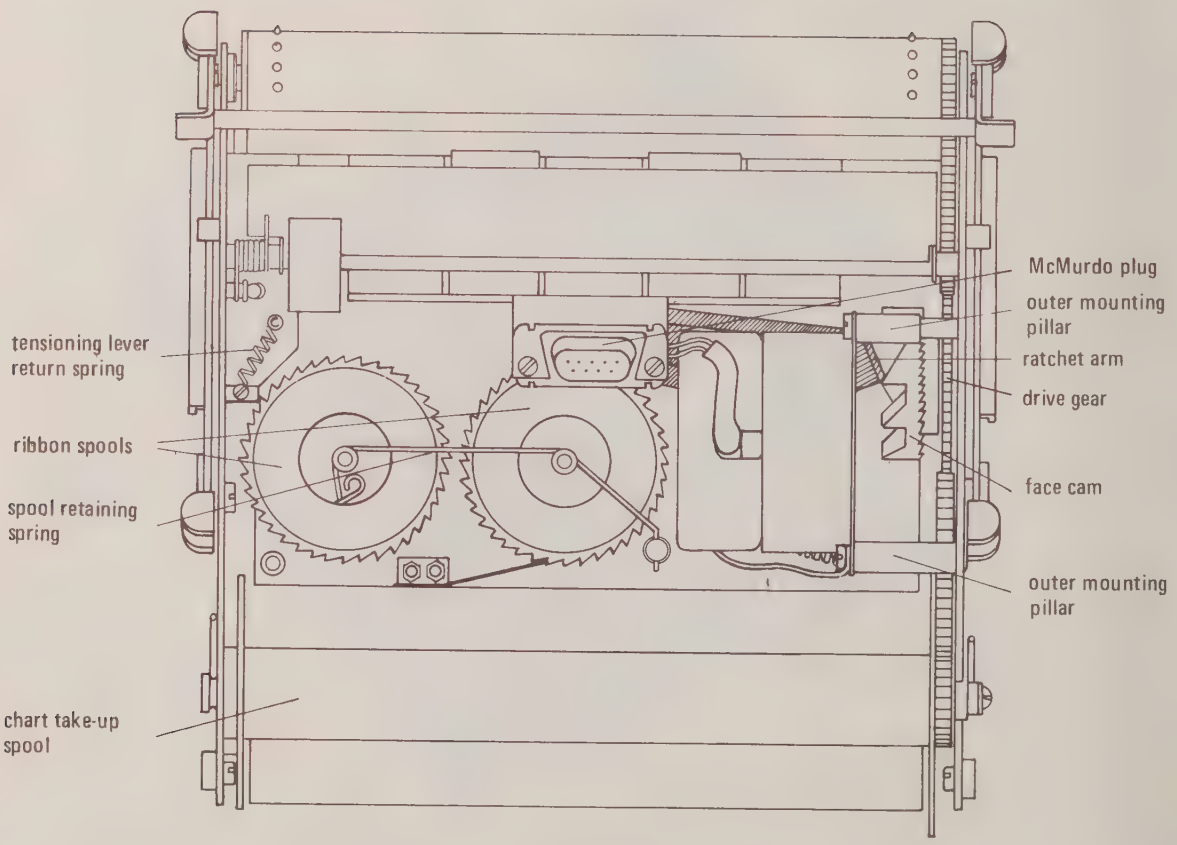


Fig. 32. Chart Unit Assembly – Chart and Ribbon Drive.

Selector Drive System

Carry out checks of the main areas defined below:

Drive Motor
Dotting mechanism
Servo muting switch
Secondary shaft drive
Rotary channel selector switch
Colour cams, ribbon frame positioner/channel indicator

Drive Motor

If the motor drive shaft does not rotate when the mains supply is switched on, carry out a visual check for possible obstruction due to misalignment of cams, driven member or rotary switch — see alignment procedure page 71.

Confirm that the drive motor 115V AC supply is present at the motor terminal block. If the supply voltage is present the drive motor should be replaced.

To do this, disconnect the mains supply and motor leads at the terminal block. Undo the two 6BA screws, securing the motor to the extrusion.

Before the motor shaft can be withdrawn the two 6BA grub screws securing the mute cam to the drive spindle must be **eased.** If the grub screws are not readily accessible rotate the motor housing about the drive shaft.

ENSURE THAT THE ALIGNMENT OF THE MUTE CAM IS NOT DISTURBED.

If the supply voltage is not present at the motor terminal block, remove the chart unit by lifting the chart unit disconnecting lever — Fig. 12 when the unit will tilt forward ready to be lifted out.

Monitor the voltage at McMurdo socket pins 6 and 8 this should be 115V AC. If the voltage is not present at this location monitor the voltage at main terminal block pins 14 and 13.

If necessary disconnect the mains supply and carry out the continuity checks described below, referring to Fig. 33.

Between main terminal block	pin 13 and McMurdo socket	pin 8
	pin 14	pin 6
Motor terminal block	(orange lead)	pin 7
—	(blue lead)	pin 8

Also check that there is continuity between McMurdo **plug** pins 6 and 7. These pins are connected by a shorting link at the rear of this plug on the chart unit.

Repair wiring as necessary.

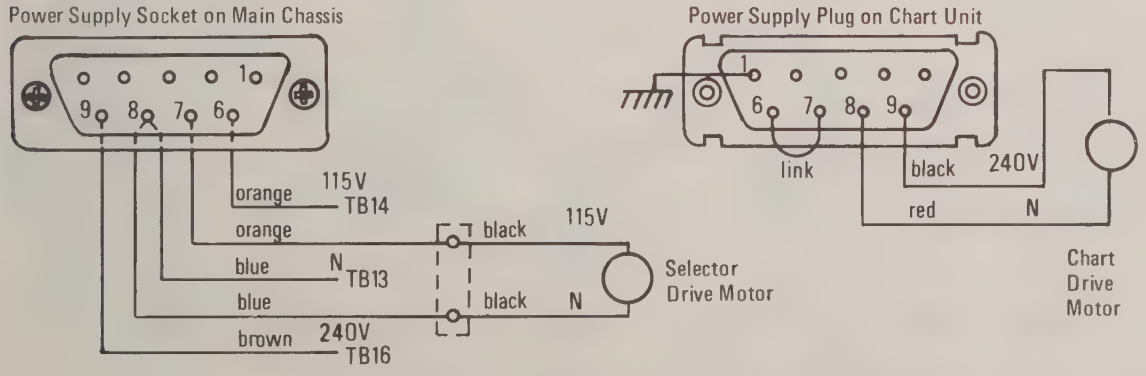


Fig. 33. Selector Drive and Chart Drive Power Supplies

Dotting Mechanism

If a fault occurs in the dotting mechanism carry out a visual check of the following:

Dotting cam assembly for normal rotation and correct alignment – see page 75.
Chopper bar assembly to ensure that there is sufficient tension on the spring to move the chopper bar – see Fig. 34.
Stylus arm for correct vertical dotting movement.

Servo Muting

During channel changeover the servo-system is inhibited, hence the linear motor should remain stationary during this period. If it does not do so the fault may lie in the microswitch operated by the muting cam or be due to a break in the interwiring between fanning strip and microswitch.

Check the operation of the switch by connecting an Avometer set to 2.5V DC between fanning strip pins 1 (–ve) and 2 (+ve). The voltage should switch from zero volts to approximately 0.7V DC when the switch is depressed – servo system 'enabled'.

If necessary carry out visual/continuity checks between fanning strip and microswitch connections. Repair as necessary.

A faulty micro switch may be changed by removing the two 6BA screws securing the switch mounting plate and detaching the switch – two 8BA screws and washers.

Secondary Shaft Drive

Intermittent drive to the shaft is transmitted by the switch drive cam and driven member. Misalignment of the two parts may damage one or both and cause the rotary channel selector switch and colour cams to be incorrectly positioned, see page 75 for alignment procedure or page 65 should replacement be necessary.

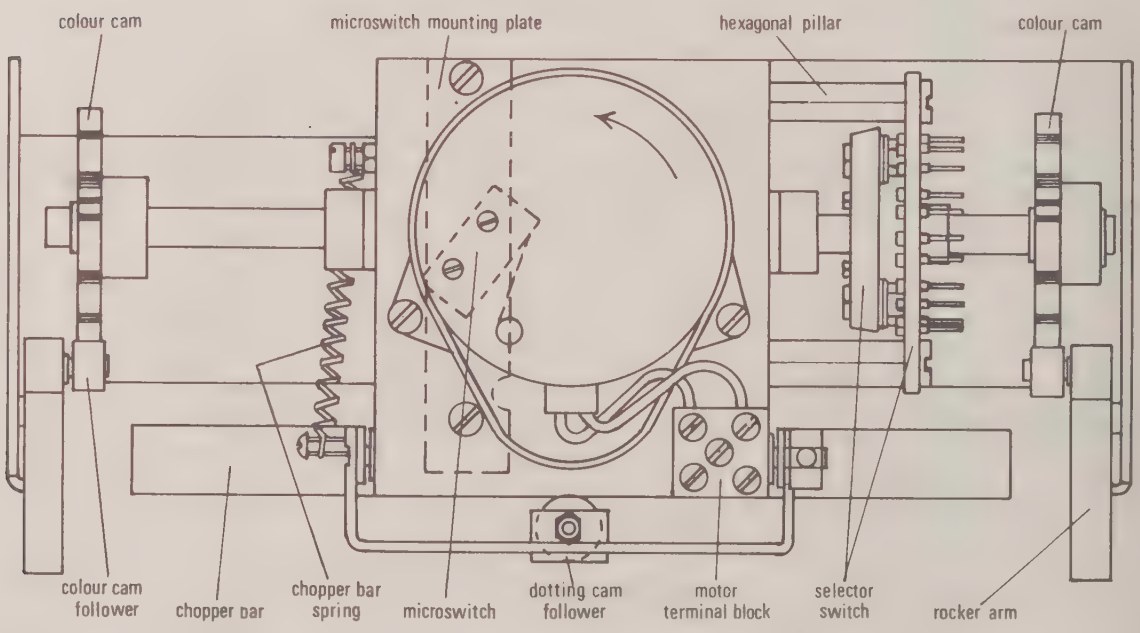


Fig. 34. Selector Drive Assembly.

Channel Selector Switch

If the intermittent drive to selector switch is functioning normally but a switching fault develops, a visual examination may reveal a short circuit between stud contacts due to accumulated debris or bad contact between the switch wiper and stud contacts. This may cause the linear motor to behave erratically or be permanently deflected to one end of the scale. Such behaviour may also result if the switch is not aligned with the connections to which the incoming signals are routed. In millivolt or thermocouple signal input versions connections are made to alternate stud contacts only.

Check the wiring to the switch and if necessary clean between the wiper segments and between the stud contacts using a soft nylon tooth brush. Do not use switch contact cleaner, e.g., CO_2 spray, or make any attempt to lubricate the contacts.

If it is necessary to replace the selector switch refer to page 63.

Colour Cams, Ribbon Frame and Channel Indicator

Intermittent drive to the colour cams is transmitted by the driver assembly and secondary drive shaft to which the colour cams are keyed. Hence a fault in the driver assembly will bring about incorrect functioning of the colour cams. A rocker arm assembly for each colour cam has a cam follower attached which is kept in close contact with the colour cam by the ribbon frame pressing against the opposite end of the rocker arm assembly, two springs retain the ribbon frame in position. As the cam follower traverses the contour of the colour cam a reciprocal movement is imparted to the rocker arm which moves the ribbon frame, against spring tension, to the requisite channel colour position.

Failure of either spring or the incorrect adjustment of the ribbon frame adjustment screws —see below, may result in the ribbon frame being wrongly positioned beneath the dotting mechanism, hence the recorded dot may not be of the colour related to the measured channel.

As the channel indicator is positioned by the movement of the ribbon frame assembly an error in channel indication may also occur.

To replace the spring, remove the chart unit, undo the 6BA lock nut and screw and release the hooked end of the spring from the ribbon frame assembly – see Fig. 30. Page 36.

Replacement of colour cams is dealt with on page 65.

To correct ribbon frame misalignment refer to page 76.

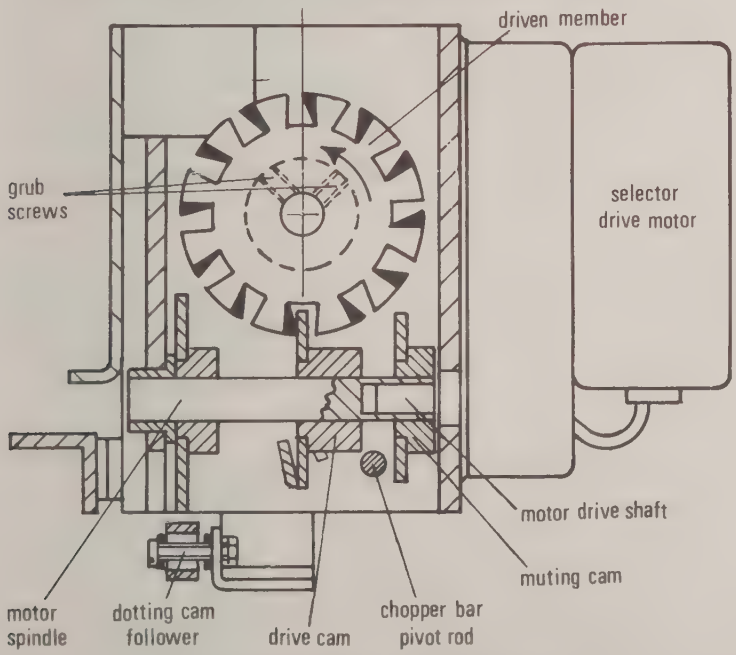


Fig. 35. Selector Drive Cams.

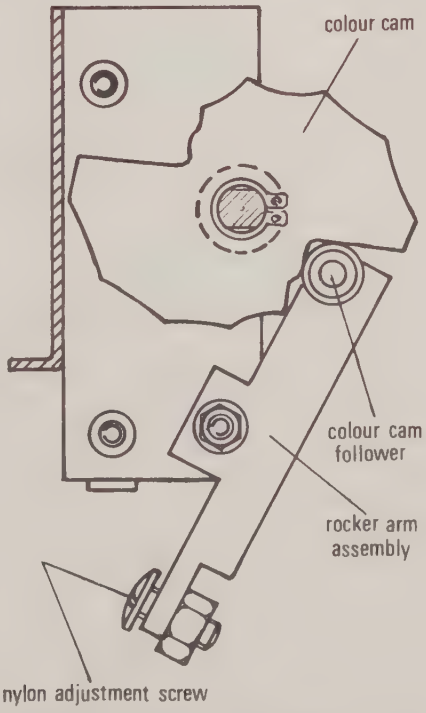


Fig. 36. Colour Cam/Rocker Arm Assembly.

FAULT FINDING TABLES

The following abbreviations are used in these tables:

Avo — Avometer
HSP — High Set Point
LSP — Low Set Point
pcb — printed circuit board
PSU — Power Supply Unit
TC — Thermocouple
Amp. pcb — Amplifier printed circuit board
Relay pcb — Relay/Alarm printed circuit board
E/F pcb — Emitter follower printed circuit board
RC — Range card
RCC — Range card connector
T/E — Thermoelectric

TABLE 1: FAULTS IN THE INDICATING SYSTEM

No Drive to Linear Motor

Note:— Move the linear motor carriage manually for tests marked thus *

	Test	Go result	Refer to	Go	No Go
	Apply an input signal which would normally drive the linear motor carriage to approximately mid-scale position				
1	* Check for obstruction	Motor moves freely		Test 2	Clear obstruction
2	Mains AC supply on terminal block pins 16 15 14 13	 240V 200V 115V Neutral	p. 19	Test 3	Check mains supply source & leads.
3	AC secondary voltage at mains transformer pcb pin 1 2 3	 11.5V 0V 11.5V	p. 20	Test 4	Check interwiring between terminal block pins and mains transformer. If interwiring correct change PSU.
4	DC voltage at both electrolytic capacitors mounted on mains transformer pcb.	+ 15V — 15V	Fig. 14	Test 5	Change PSU.
5	DC voltage on amp. pcb pin 11 14 15	0V + 15V — 15V	p. 21	Test 6	Check interwiring between PSU and amp. pcb. Repair if necessary.
6	DC voltage on amp. pcb pin 3 11	— 6.2V 0V	p. 21	Test 9	Voltage zero:— check interwiring between PSU and amp. pcb. Repair if necessary. Voltage high:— go to Test 7.

	Test	Go result	Refer to	Go	No Go
7	Disconnect wire(s) from amp. pcb pin 3. Connect a 390 ohm resistor between the disconnected wire(s) and amp. pcb 0 volt (pin 11). Monitor DC voltage across the resistor.	approx. – 4.5V	Fig. 14	Change amp. pcb	Change PSU—go to Test 8
8	Reconnect wire(s) to amp. pcb pin 3. Remove 390 ohm resistor. Recheck DC voltage between amp. pcb pins 3 and 1.	– 6.2V		Test 9	Change amp. pcb
9	Switch off mains supply. Check interwiring between Amp. pcb pin — Range card connector pin 8 — 3 7 — 6	Continuity established	p. 26 Fig. 20	Test 10	Repair interwiring.
10	Remove muting switch connection to fanning strip pin 1. Switch on mains supply.	Linear Motor drives	Fig. 14	Replace micro-switch and reconnect leads to fanning strip.	Test 11.
11	Switch on mains supply. * DC voltage between amp. pcb pins 16 and 5 (Linear motor coil voltage — depends on indicating pointer position.)	Between + 11V & – 11V	p. 21	Test 12	If no voltage change amp. pcb.
12	* Linear motor coil voltage between Fanning strip pins 7 and 8.	Between + 11V & – 11V	p.21	Test 13	Check continuity between F. Strip — Amp.pcb 7 — 16 8 — 5 Rewire if necessary.
13	Continuity of linear motor coil at coil lead outs.	68 ohms nominal	p.21	Change the umbilical cord	Change linear motor assembly.

TABLE 2: FAULTS IN THE INDICATING SYSTEM

Linear Motor Movement — (A) Restricted
(B) Indication inaccurate
(C) Oscillatory

Note:– Move the linear motor carriage manually for tests marked thus *

	Test	Go result	Refer to	Go	No Go
A1	* Check for indicating pointer touching the bottom of the scale and that the umbilical cord has free movement.	Motor moves freely	p.23	Test A2	Make necessary adjustment
A2	Monitor DC voltage at slidewire terminal pins using Avo prods DO NOT USE CROCODILE CLIPS AS DAMAGE MAY RESULT.	–6.2V	p.23	Clean slidewire & slidewire contacts. If the fault persists change slidewire.	Voltage present but incorrect carry out Tests 7 and 8 in Table 1.
B1	Carry out tests A1 and A2 together with corrective procedure.		p. 23		Indication still inaccurate. Test B2.
B2	Replace range card and recalibrate.	Indication correct	p. 27	Check faulty range card components	Test B3.
B3	Carry out voltage check between wiper and one end of zeroing potentiometer RV2 while rotating pot. over full traverse	Varies linearly between 0 and – 6.2V	p. 26	Test B4	Change RV2
B4	Switch off mains supply. Withdraw range card. Connect ohmmeter across span pot RV1. Check that the resistance varies over full traverse.	Varies linearly between 0 & 47k	p. 27	Test B5	Change RV1
B5	Switch on mains supply. Check DC volts on E/F pcb pin 2 4 with respect to pin 3	 + 15V – 15V	p. 27	Test B6	Repair interwiring.
B6	Insert range card. Press home firmly. Disconnect switch wiper **link wires** from turret lugs on Sel. S.W. Connect a F-C portable potentiometer for mV or TC inputs, OR a decade resistance box for R/T inputs between turret lugs on selector switch. Inject a signal equivalent to each of the normal mV or TC signal input levels OR set the resistance box to the value appropriate to each R/T temperature.	Indication correct at each simulated temp.	p. 27 B.S. or DIN tables	Test B7	Change amp. pcb.

	Test	Go result	Refer to	Go	No Go
B7	Check continuity between main terminal block and selector switch.	Continuity established	Fig. 22	Clean contacts and /or realign.	Repair interwiring
C1	Switch off mains supply. Check that R23 is 470k.	Value confirmed	Fig. 15 or 16	Test C2	Fit correct resistor.
C2	Carry out continuity checks between: Amp. pcb Pin — Range card connector pin 4 — 15 6 — 16	Continuity established	Fig. 22	Test A2	Repair interwiring
C3	Disconnect leads from pins 1 and 5 on emitter/follower pcb, connect these two leads together.	Oscillation cured.	p.27	Change E/F pcb.	Reconnect leads to pins 1 and 5 respectively and carry out test A2 Table 2.

TABLE 3 : FAULTS IN THE INDICATING SYSTEM

Linear Motor drives up or down scale — A Slowly
B Quickly

	Test	Go result	Refer to	Go	No Go
A1	Carry out test B5 and if appropriate test B6 in **TABLE 2**				
B1	Switch off mains supply and carry out continuity checks between: Amp. pcb pin — Range card connector pin 1 — 14 9 — 4 ACJC transistor and 4 Then between Amp. pcb pin — E/F pcb pin 17 — 5 2 — 1	Continuity established	Fig. 21	Test B2	Repair interwiring
B2	Switch on mains supply and check DC voltage between amp. pcb pins 9 and 11.	— 0.6V ± 0.03V	p. 26	Test B3	Replace ACJC transistor.
B3	Check DC voltage at slidewire termination pins using Avo prods. DO NOT USE CROCODILE CLIPS AS DAMAGE MAY RESULT.	— 6.2V ± 0.3V	p. 23	Test B4	Voltage present but incorrect. Carry out Tests 7 & 8 in Table 1.
B4	Check the indicating pointer contact voltage with respect to amp. pcb pin 11 (0V) at amp. pcb pin 17 and fanning strip pin 6. (varies according to position of pointer).	Varies between 0V and 6V	p. 25	Test B5	Repair interwiring.
B5	Unplug input signal sockets from rear of instrument. Check for shortcircuit between selector switch wiper segments.	No short circuit present	p. 41	Test B6	Clean/Realign selector switch contacts.
B6	Carry out Tests B2 to B6 in **TABLE 2** as necessary.				

TABLE 4 : FAULTS IN THE INDICATING SYSTEM

Undue Sensitivity to — (A) Ambient Temperature variations
(B) Mains Voltage variations

	Test	Go result	Refer to	Go	No Go
A1	Check DC voltage between amp. pcb pins 9 and 11.	— 0.6V ± 0.03V	p. 26 Fig. 14		Check interwiring between amp. pcb pin 9 and ACJC transistor. If correct change transistor.
B1	Connect a 680 ohm resistor between fanning strip pins 2 and 5. Measure the voltage across the resistor.	approx. 4V DC	p. 23		Change PSU

TABLE 5 : FAULTS IN THE INDICATING SYSTEM

Pointer indicates at only one position on the scale.

Chart drive operating normally.

	Test	Go result	Refer to	Go	No Go
1	Make a visual check to confirm that the selector drive motor is operating.	Motor shaft rotating		Test 5	Test 2
2	Check that voltage is present at motor terminal block.	240V AC	Fig. 40	Check for mechanical obstruction If clear change motor	Test 3
3	Check mains supply between main terminal block pins 16 and 13 (neutral)	240V AC	Fig. 13	Test 4	Check mains supply source and leads
4	Disconnect mains supply and check continuity from main terminal block via McMurdo plug and socket.	continuity established	Fig. 22	Test 5	Repair interwiring.
5	Check the alignment and correct positioning of drive gear/driven member and the muting cam. Ensure that each is firmly attached to the respective shafts.	correctly aligned and secured.	p. 71 Fig. 55	Test B5 Table 3	Align and secure mechanical parts as necessary.

TABLE 6 : FAULTS IN THE INDICATING SYSTEM

(A) **Irregular dotting pattern**
(B) **Incorrect dot colour**

Selector drive assembly operating correctly.

	Test	Go result	Refer to	Go	No Go
A1	Carry out Test B5 TABLE 2			Clean selector switch and contacts and check their alignment	Clean slidewire and slidewire contacts.
B1	Check external/internal signal connections to terminal block and selector switch termination pins.	Correctly connected	Fig. 22	Test B2	Correct the wiring
B2	Check that both the rocker arm assemblies and the ribbon frame are positioned correctly by the colour cams.		p. 73		Check/adjust mechanical function of (i) Ribbon frame (ii) Return springs (iii) Rocker arm assembly (ensure moulded nylon screws are set correctly).

TABLE 7 : FAULTS IN RELAY ALARM SYSTEMS

Relay — (A) Remains energised
(B) Switches at wrong position of Indicating Pointer

Indicating system operating normally.

	Test	Go result	Refer to	Go	No Go
A1	Carry out TABLE 8, Test 1 followed by Test 5 and 7 (exclude Tests 2, 3, 4, & 6)				
B1	Adjust controller amplifier balance potentiometer on alarm pcb. RV101 for LSP RV201 for HSP		p. 70		If outside adjustments change relay pcb.

TABLE 8 : FAULTS IN RELAY ALARM SYSTEMS

Relay does not energise or energises momentarily

Indicating system operating normally

Move the linear motor carriage manually for tests marked thus *

	Test	Go result	Refer to	Go	No Go
1	* Change Relay	Relay operates correctly			Test 2
2	* Remove relay(s) and check DC voltage at relay socket pins 2 and 7.	OV or approx. 25V	p. 33 Fig. 21	Change relay	Test 3
3	* Check differential voltage between Alarm pcb pins 1 & 2 for HSP 1 & 5 for LSP (depends on position of pointers)	Between 0V & 6V	Fig. 28	Change alarm pcb	Test 4
4	Check DC voltage between slidewire 0V terminal pin and set point contact(s).	Between 0V & 6V	p. 34	Test 5	Test 7
5	Check differential volts between Fanning strip pins 6 & 3 for HSP 6 & 4 for LSP	Between 0V & 6V	p. 34	Test 6	Repair interwiring
6	Switch off mains supply and check continuity between: Fanning strip & Alarm pcb pin 6 pin 1 3 2 4 5	Continuity established	Fig. 27	Test 7	Repair interwiring
7	Clean slidewire and set point contacts. Recheck DC voltage between Slidewire 0V terminal pin and set point contact(s)	Between 0V & 6V	p. 54		Change slidewire

TABLE 9 : FAULTS IN RELAY ALARM SYSTEMS

Neon — Fails to operate

Indicating system operating normally

Move linear motor carriage manually past set point(s) for tests marked thus *

	Test	Go result	Refer to	Go	No Go
1	* Carry out visual check to prove operation of relay(s)				Test 2
2	* Change relay(s)		p. 56		Test 3
3	Remove relay(s) and check DC voltage on relay socket(s) pins 2 & 7 on HSP pins 2 & 7 on LSP	0V or 25V	p. 33	Test 4	Carry out test detailed in Table 7 to prove relay
4	Check AC voltage between terminal block pins 13 & 14	115V	p. 34	Test 5	Refer to page 19
5	Check AC voltage between terminal block pin 13 and alarm pcb pin 11	115V	p. 34	Test 6	Test 7
6	Check AC voltage between terminal block pin 13 and relay socket pin 1, HSP & LSP	75V	p. 34	Test 8	Change relay pcb
7	Switch off mains supply and check continuity between terminal block pin 14 and alarm pcb pin 11	Continuity established	p. 34		Repair interwiring
8	* Insert relay(s) and check AC voltage between terminal block pin 13 and alarm pcb pin 9 for HSP 14 for LSP	75V	p. 34	Test 9	Change relay pcb
9	* Check AC voltage between neon socket: pins b(or 3) and a(or 2) pins b(or 3) and c(or 1)	75V	p. 34	Test 11	Test 10
10	Switch off mains supply and check continuity between neon socket pin b (or combo connector pin 3) and terminal block pin 13 neon pin a (pin 2) and alarm pcb pin 9 neon pin c (pin 1) and alarm pcb pin 14 as necessary.	Continuity established	Fig. 22	Test 11	Repair interwiring
11	Check AC voltage at the base of HSP and LSP neons.	75V	p. 34	Change neon	Repair interwiring

TABLE 10 : FAULTS IN THE CHART DRIVE SYSTEM

(A) Chart not driving
(B) Ribbon not driving

Test		Go result	Refer to	Go	No Go
A1	Check AC voltage between pin 8 and pin 9 on McMurdo socket on the main chassis	240V	p. 20 Fig. 33	Test A2	Check wiring between mains input terminal block pins and McMurdo socket
A2	Make visual/continuity check between McMurdo plug and chart motor	Continuity established	p. 36 Fig. 30	Test A3	Repair wiring
A3	Check that the face cam is not slipping on the drive shaft	Face cam secured	p. 36 Fig. 32	Test A4	Tighten grub screws
A4	Remove the drive motor Check free movement of gear train and rotation of chart take up roller	Gears move freely, chart moves on	p. 36 Fig. 32	Replace chart motor	Remove obstruction or replace cassette
B1	Move ratchet lever manually. Check that non-return spring engages correctly in spool ratchet at each step	Take up spool moves on	p. 37 Fig. 31	Test B2	Carefully adjust/ replace non-return spring
B2	Check that the face cam is not slipping on drive shaft	Face cam secure	p. 37 Fig. 32	Test B3	Tighten grub screws
B3	Check that the ratchet lever return spring is operative		Fig. 31	Replace cassette	Replace spring

DISMANTLING AND REASSEMBLY

Unless otherwise stated the reassembly procedure is the reverse of the dismantling procedure.

To remove the Chart Unit — see Fig. 37

A lever to the right of the Chart Unit disconnects the Chart Unit from the main chassis. When the lever is pushed up the unit can be lifted out.

To remove the Main Chassis from the Case — see Fig. 12

Remove the Chart Unit.
The main chassis is retained in its case by a screw through its centre. Turn the knob of this screw approximately 10 turns anti-clockwise to free the chassis, and withdraw it from the case.

To change the Linear Motor Assembly — see Fig. 38

CAUTION: If the magnetic circuit components are separated the magnets will lose power and need remagnetizing. Handle the linear motor carefully. Pressure on the coil moulding may damage the plastic rider which bears against the magnetic return plate.

The indicating pointer and linear motor carriage, magnet pole pieces, field forming rod and magnetic return plate form one assembly WHICH MUST NOT BE BROKEN DOWN but may be exchanged as a unit complete with the slidewire and motor chassis. Remove the linear motor cover plate by undoing two screws. Slacken the eight screws in the fanning strip connector and release the cable form. Disconnect the in-line plug and socket in the cable supplying the neon indicators. Loosen the four 6 BA nuts with washers on the studs protruding from the rear of the linear motor. Lift the linear motor assembly until the lower pair of nuts and washers are in line with the holes at the end of the keyhole slots and separate the linear motor assembly from the main chassis. Remove the two screws from the scale and with the pointers at mid-scale slide it sideways taking care not to damage the pointers or scratch the scale.

When replacing the linear motor assembly, reverse the above procedure making sure that the washers are not trapped between the linear motor and the chassis.

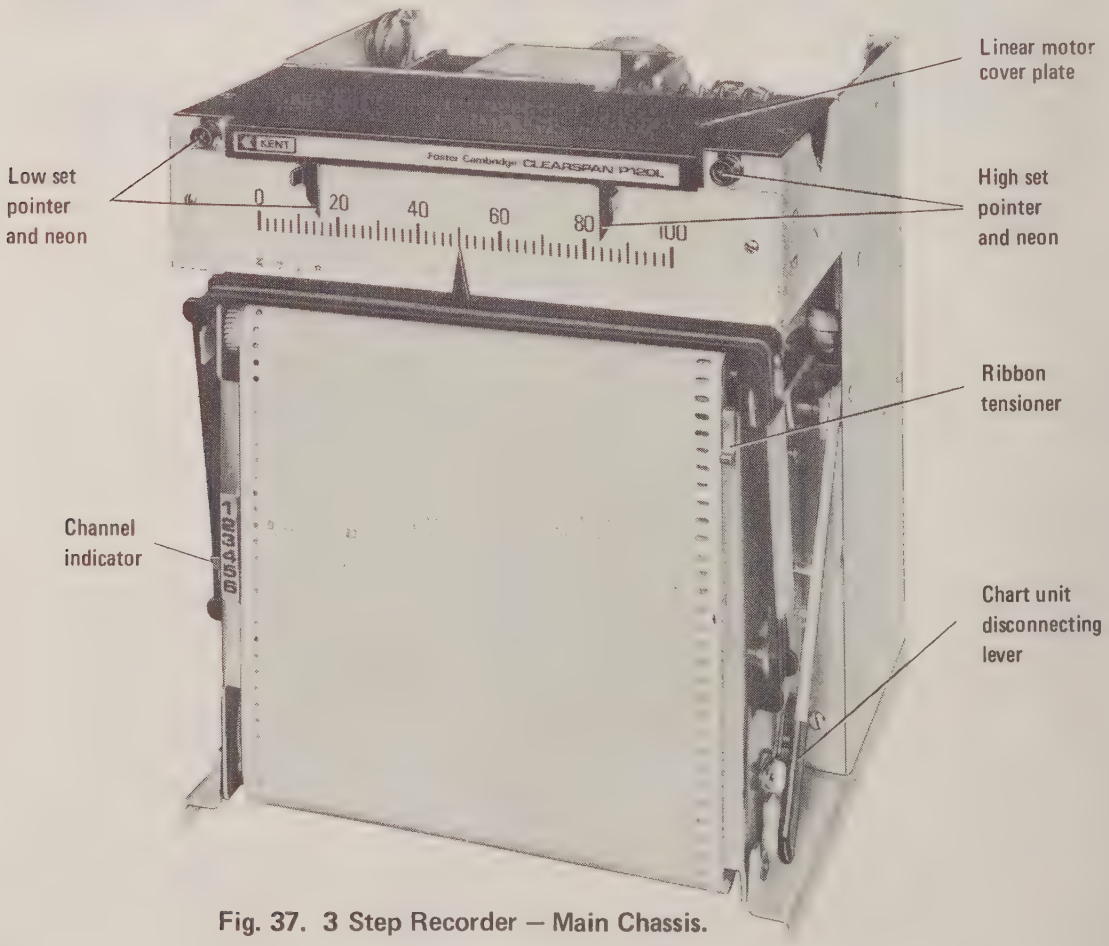


Fig. 37. 3 Step Recorder — Main Chassis.

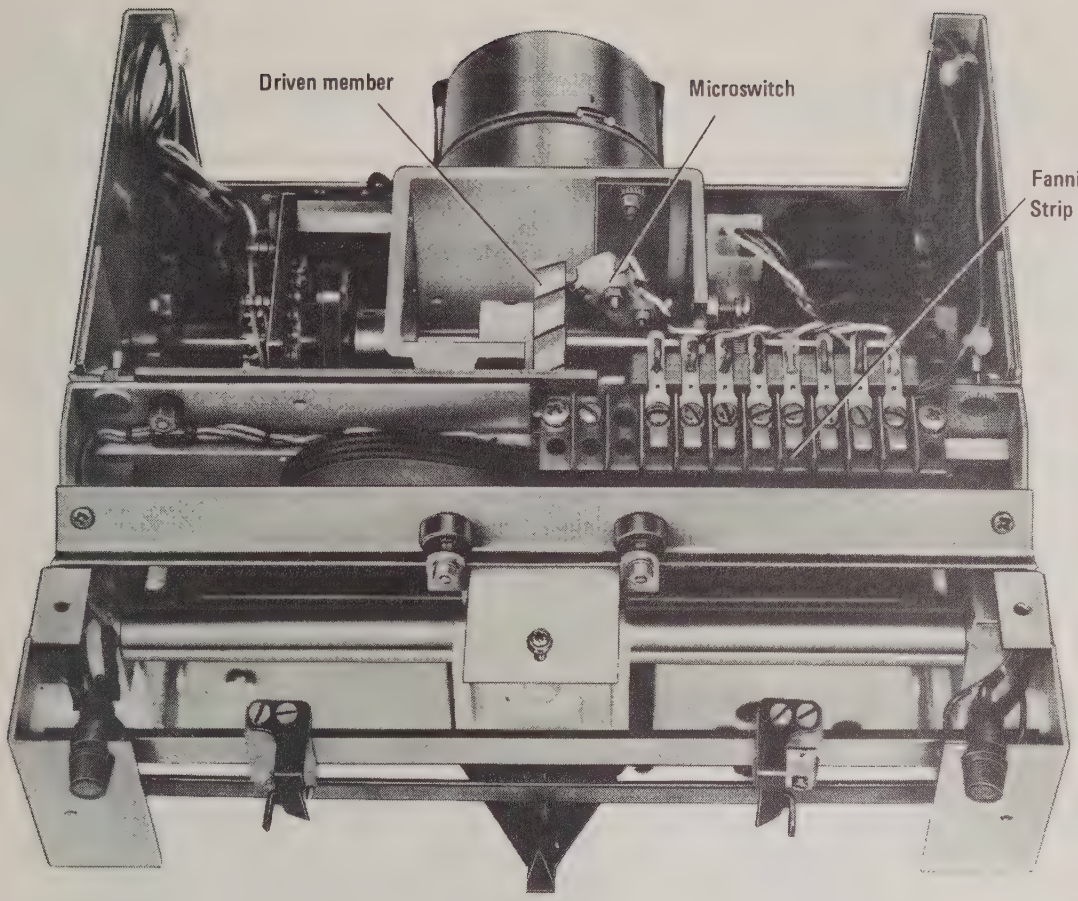


Fig. 38. Linear Motor Assembly – (viewed from above)

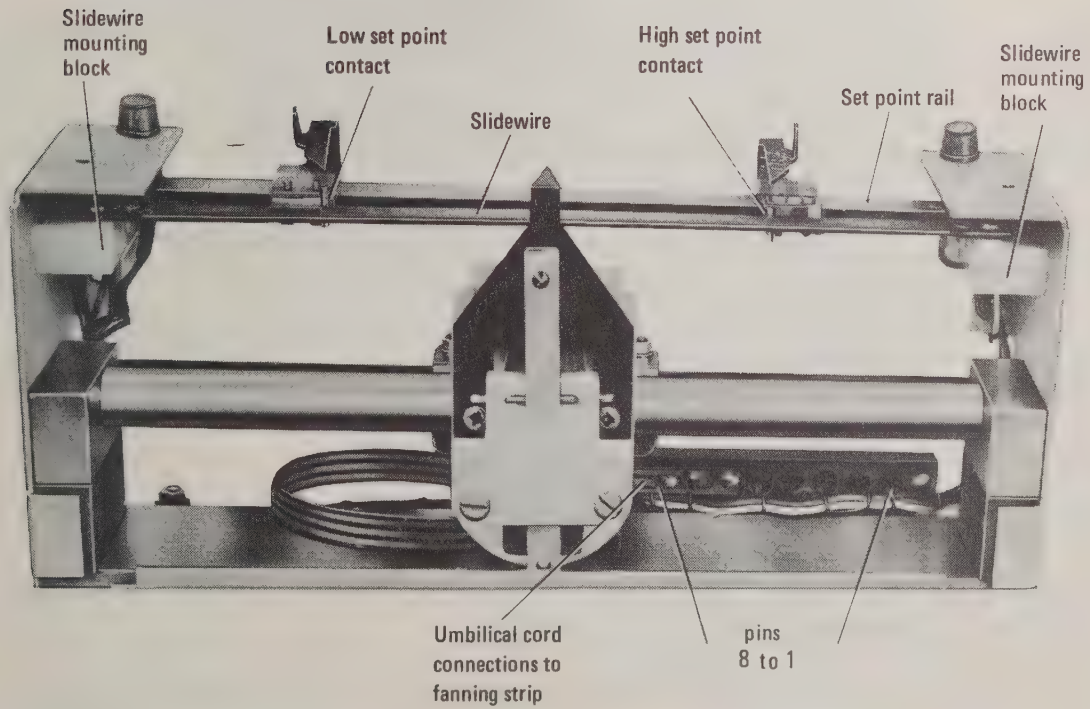


Fig. 39. Linear Motor Assembly – (viewed from below)

To change the Slidewire — see Figs. 38 & 39

DO NOT TOUCH THE SLIDEWIRE WINDING WITH BARE HANDS AS CONTAMINATION WILL OCCUR. If by accident you do so, wash the slidewire in Genklene as soon as possible.

Remove the main chassis from the case — see page 52. Undo the screws retaining the linear motor cover plate and remove it.

Unscrew the scale and with the indicating pointer and set pointer(s) at mid-scale, bow the scale slightly, lift it off the neons and slide it sideways very carefully so as not to damage the pointers or scratch the scale. Gently lift the neon indicators out of their slots.

Remove the screws from each side of the chassis which hold the slidewire mounting blocks in place. Lift the set point rail and slidewire assembly clear of the linear motor frame.

Unsolder the wire from each slidewire terminal pin. Remove the screw from each end of the slidewire former, releasing it from the mounting blocks.

LEAVE SUFFICIENT OF THE PROTECTIVE PAPER COVERING ON THE REPLACEMENT SLIDEWIRE TO PREVENT HANDLING DURING ASSEMBLY.

Re-assemble in reverse order. Carefully remove the remainder of the protective paper.

Move the linear motor carriage to check that continuous contact is maintained along the full length of the scale.

If set pointers are fitted check that there is correct contact between the set point contacts and the upper edge of the slidewire.

Oscillation of the indicating pointer at certain points on the scale is symptomatic of a dirty slidewire or indicating pointer contact. Clean the slidewire by washing it thoroughly with Genklene using a camel-hair brush, paying particular attention to the area between the slidewire turns. Take care not to damage the contacts..

To change the Umbilical Cord — see Figs. 38 & 39.

Remove the main chassis from the case and separate the linear motor assembly from the main chassis — see page 52. Undo the screws retaining the linear motor cover.

Undo the two screws securing the fanning strip connector block and ease it away from the chassis. Lifting the connector block carefully and supporting it on its side, slacken the screw holding the umbilical clamp. Unsolder the linear motor coil flying leads and both ends of the umbilical cord.

Before fitting a new cord remove any surplus solder from the linear motor carriage solder lugs and fanning strip termination pins 6, 7 and 8. Position the replacement cord, track side up, over termination pins 6, 7 and 8, press firmly home and make soldered connections.

Refit the umbilical cord clamp.

Using a pair of plain tweezers — DO NOT USE SERRATED TYPE — bend the umbilical cord gently upwards and ease it through the recess for the connector block pins.

Invert the linear motor assembly, lead the umbilical cord round smoothly and slot the free end over the two pins attached to the linear motor carriage.

Solder the umbilical cord in position. Re-solder the linear motor coil flying leads.

Ease the fanning strip back into position, ensuring that no kinking of the umbilical cord occurs.

To replace the Power Supply Unit – see Fig. 40

Detach the amplifier pcb from the main chassis by removing the four 6 BA screws. Remove the termination plate assembly and detach the power supply unit from the chassis bulkhead by removing the four 4 BA units.

The power supply unit is linked to the amplifier pcb, range card connector and alarm pcb (if fitted) by DC supply lines and to terminal block pins 6, 13, 14, 15 and 16 to which the earth, neutral, 115V, 200V and 240V primary leads are connected – see wiring diagram Fig. 22, 23, 24 & 25.

Unsolder the DC supply lines from the power supply unit and the AC supply lines from the terminal block pins, referred to above, taking care not to disturb other connections.

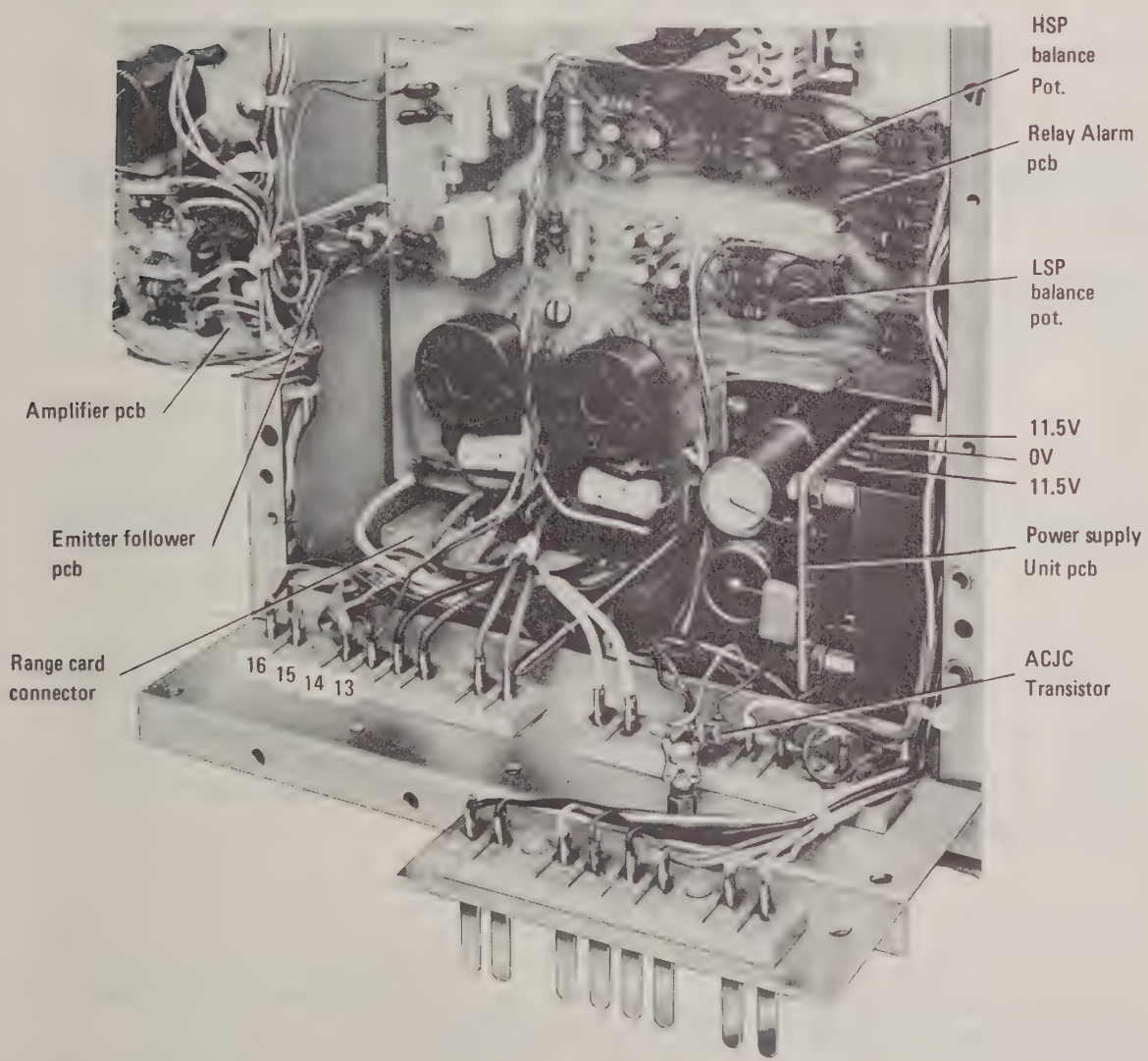


Fig. 40. Interior view of Main Chassis

To replace the Amplifier pcb — see Fig. 40

Detach the amplifier pcb from the main chassis by removing the four 6 BA screws. Before disconnecting any wires from the amplifier pcb make a written note of their colour and position.

The replacement pcb while being similar in component layout may have a different type number as the latest issue board will be supplied for spares purposes, being interchangeable with previous issues.

To replace the ACJC Transistor — see Fig. 40

Considerable care should be taken when fitting a new ACJC transistor as it is easily damaged by excessive heat or mechanical strain.

Remove the five screws holding the termination plate assembly in place. Unsolder the faulty transistor which is connected between pin 5 and the stand-off insulator. Hold the lead-out wires of the replacement transistor with a small pair of long-nosed pliers to act as a heat shunt and join the base and collector leads together before soldering into place. Use a 15 watt pencil iron and 22 SWG 60/40 resin-cored solder.

To replace the Relay Alarm pcb — see Fig. 40

Detach the Amplifier pcb.

Unplug the alarm relay(s) by pushing a screwdriver through the appropriate hole(s) in the chassis behind the chart unit — see Fig. 51. Undo the three screws securing the pcb. Unsolder the wire connections from the terminal pins noting the colour and position of the wires.

Fit the replacement pcb which, although being similar in component layout, may have a different type number as the latest issue board will be supplied for spares purposes, being interchangeable with previous issues. Refit the alarm relay(s).

To replace a Relay

Unplug the faulty relay by pushing a screw driver through the appropriate holes in the chassis behind the chart unit — see Fig. 51.

To replace a Neon Indicator — see Fig. 38

Undo the screws retaining the linear motor cover plate and lift it off. Gently ease the neon indicator out of its slot, slide the rubber sleeving away from the neon and unsolder the wires. Slide the spring clip off the neon and fit a new indicator. Replace the spring clip and rubber sleeving, re-assemble in reverse order.

To fit a new Scale — see Fig. 51

Unscrew the scale and with the indicating pointer and set pointer(s) at mid-scale, bow it slightly, and slide it sideways very carefully so as not to damage the pointers or scratch the scale.

Dirt or grease marks on the scale can easily be removed by lightly rubbing with a pad soaked with Genklene, supplied by I.C.I.

To replace a Slidewire Contact — see Figs. 38 & 39

Move the indicating pointer and set pointer(s) to mid-scale. Undo the screws securing the scale and slide it out sideways very carefully so as not to damage the pointers or scale.

High Set Pointer Contact

Remove the two screws securing the set pointer to the mounting block and lift off the pointer.

Remove the two screws securing the spring contact to the front of the mounting block and carefully remove the contact. Take care not to touch or damage the slidewire.

Fit a new contact and check that it bears correctly on the top of the slidewire.

Low Set Pointer Contact

Gently lift the neon indicators out of their slots. Remove the two screws from each side of the chassis which hold the slidewire mounting blocks in place. Carefully lift the set point rail and slidewire assembly clear of the linear motor frame.

Remove the two screws securing the spring contact to the back of the mounting block and carefully remove the contact taking care not to touch or damage the slidewire.

Fit a new contact and check that it bears correctly on the top of the slidewire.

Indicating Pointer Contact

To replace the indicating pointer contact, remove the chart unit, turn the instrument upside down and remove the stylus arm assembly — two 6 BA screws. Undo the pozidriv screws securing the indicating pointer contact and clamping plate, slide the contact out.

In the case of instruments manufactured prior to mid-1974, where the linear motor carriage does not run on ballraces, it is recommended that an exchange linear motor is fitted as the dismantling/ re-assembly procedure is more complicated and should only be carried out by a skilled instrument technician.

To replace the Stylus Arm Assembly — see Fig. 39

Remove the chart unit, turn the instrument upside down.
Undo the two 6 BA panhead screws securing the stylus arm assembly to the linear motor coil assembly. In earlier models the stylus arm assembly is secured by two 10 BA cheesehead screws.

To replace the Emitter Follower pcb — see Figs. 40 & 41.

Undo the two 8 BA nuts securing the pcb to the bulkhead, remove the pcb spacers and unsolder the five wires. Note their position and colour.

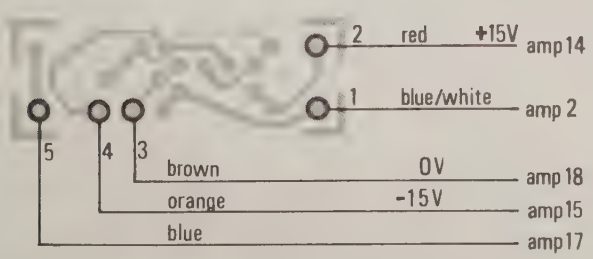


Fig. 41. Emitter Follower pcb.

To replace the Range Card — see Fig. 51

Remove the chart unit. Withdraw the range card from its socket, insert a new card into the slotted guides track side uppermost and press firmly into position. Re-check zero and span setting — see pages 68, 69 or 70.

To replace the Range Card Connector — see Fig. 40

Remove the termination plate assembly — see Fig. 14 and unplug the relays from their sockets. Undo the two 6 BA screws securing the connector to the range card guides. Unsolder the wires from the termination pins noting their colour and position.

To replace the Chart Drive Motor —see Fig. 43

Remove the chart take up spool.

Undo the two 8 BA locknuts and screws securing the McMurdo plug and unsolder the motor supply leads. Release the 6 BA panhead screw securing one of the idler gears — Fig. 42 shows which one — remove this idler. Undo the 6 BA countersunk screw positioned behind the ribbon and just above the lower ribbon guide. Undo the two 4 BA panhead screws securing the chart drive motor to the outer mounting pillars and gently remove the motor.

Using an Allen key undo the grub screws securing the moulded ratchet and gear wheel assembly— note the secured position of this assembly on the motor shaft and transfer it to the replacement motor together with the inner mounting pillar.

Fitting of the replacement motor — in the same relative position as the old motor — should be carried out as follows:

Position the motor so that the inner mounting pillar can be secured loosely to the chart frame using the 6 BA countersunk screw.

Rotate the motor to bring it into alignment with the outer mounting pillars ensuring that the brass drive gear is in mesh with its immediate idler gear. Secure the motor loosely to the outer mounting pillars using the two 4 BA panhead screws plus shake proof washers and refit the earth lead at the same time. Refit the idler gear ensuring that it meshes correctly.

Tighten the mounting pillar screws and check that the brass drive gear is not touching the side of the chassis. Solder the motor supply leads to the McMurdo plug (red lead to pin 8, black lead to pin 9) and resecure the plug to the mounting plate using the 8 BA screws and locknuts.

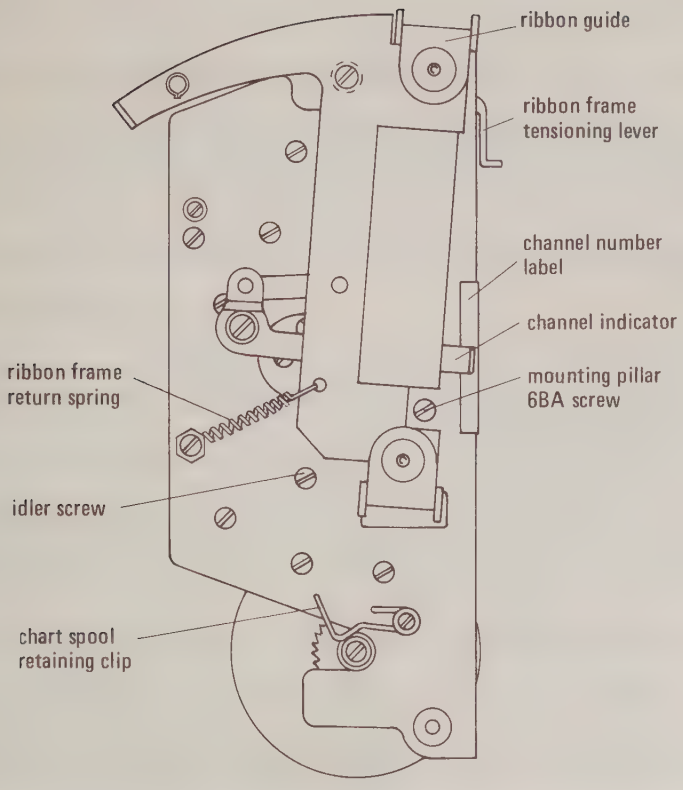


Fig. 42. Chart Unit Assembly
(viewed from left hand side)

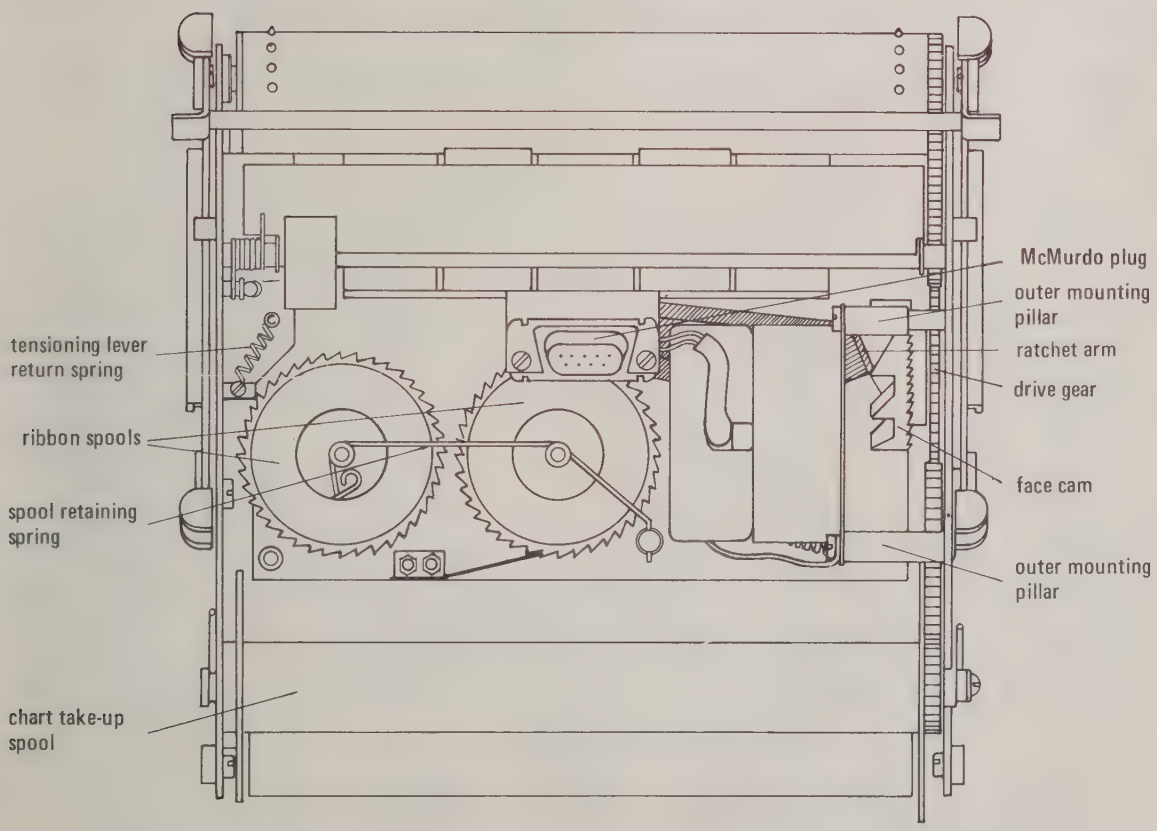


Fig. 43. Chart Unit Assembly – Chart and Ribbon Drive

To replace the Selector Drive Assembly – Fig. 44

(a) Separate the linear motor from the main chassis – see page 52

(b) Unsolder the muting switch leads from fanning strip pins 1 and 2.

(c) Release the motor supply leads to the motor terminal block.

(d) Remove the termination plate assembly from the main chassis by removing the three 4 BA screws.

(e) Unplug the relays.

(f) Unsolder the signal wires from their respective terminal block pins and range card connector pins – see Figs. 22, 23, 24 or 25.

(g) Release the cableform ties where attached to main chassis.

(h) Undo the four 4 BA screws securing the selector drive assembly to the main chassis and remove assembly.

To replace the Selector Switch – See Fig. 44

Separate the linear motor from the main chassis – page 52

Remove the circlips retaining the left hand colour cam and slide the cam off the shaft.

Detach the selector switch assembly from its mounting pillars by undoing the two hexagon shoulder screws.

Carry out procedures d, e, f, g and h above.

Remove the circlip retaining the selector switch and slide the switch off the shaft.

When fitting the replacement switch, ensure that it is mounted the right way up and correctly aligned – see alignment procedure on page 72

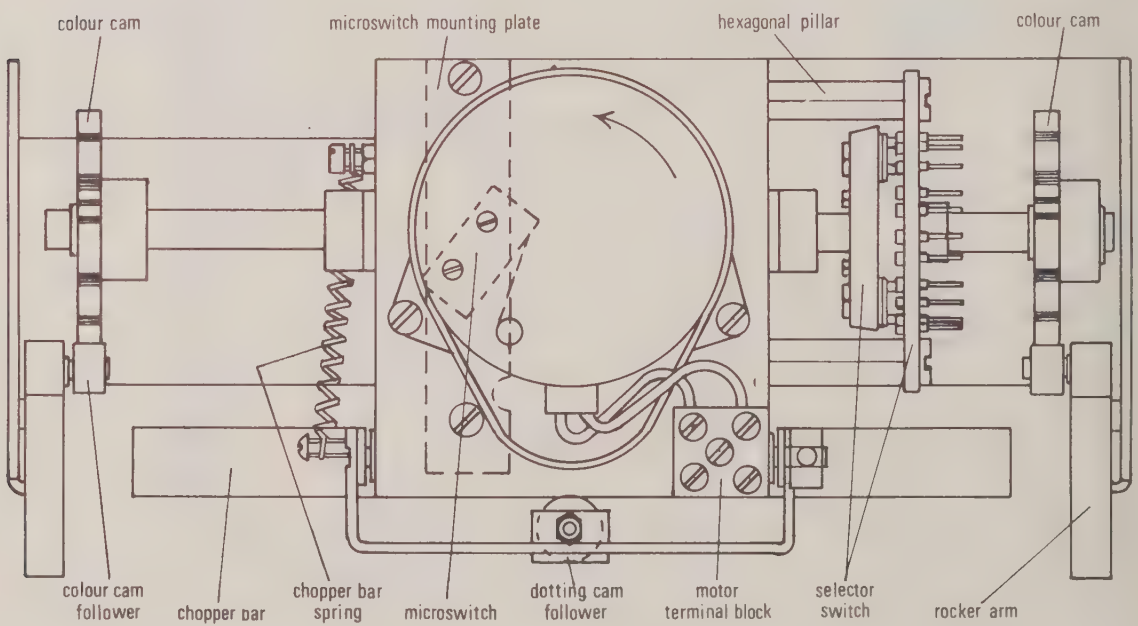


Fig. 44. Selector Drive Assembly.

To replace the Selector Drive Motor – see Fig. 44

Release the motor supply leads from the motor terminal block.

Using an Allen key, slacken the grub screws securing the muting cam to the motor drive spindle. If necessary also slacken the drive gear grub screws taking care not to alter the position of cam or drive gear. Should this occur, refer to **Alignment of Selector Drive Assembly** on page 71

Undo the two 6 BA screws securing the motor to the extrusion and withdraw the motor.

To replace the Muting Switch – see Fig. 44

Undo the two 6 BA screws securing the switch mounting plate to the motor extrusion. Unsolder the two 8 BA nuts securing the switch to the mounting plate.

To replace Muting Cam, Drive Cam and/or Dotting Cam – see Fig. 45

Separate the linear motor assembly from the main chassis – see page 52.

Undo the four 4 BA screws securing the selector drive assembly to the main chassis.

Using an Allen key, slacken the grub screws securing the muting cam, drive cam and dotting cam.

Undo the two 6 BA screws securing the motor to the extrusion and withdraw the motor.

Before securing the cams to the motor shaft, carry out the alignment procedure described on page 71.

To replace the Chopper Bar Spring – see Fig. 44

The chopper bar spring is situated to the right of the motor extrusion and is secured by two 6 BA screws which are locked in position. Release the lock nuts and screws – replace spring.

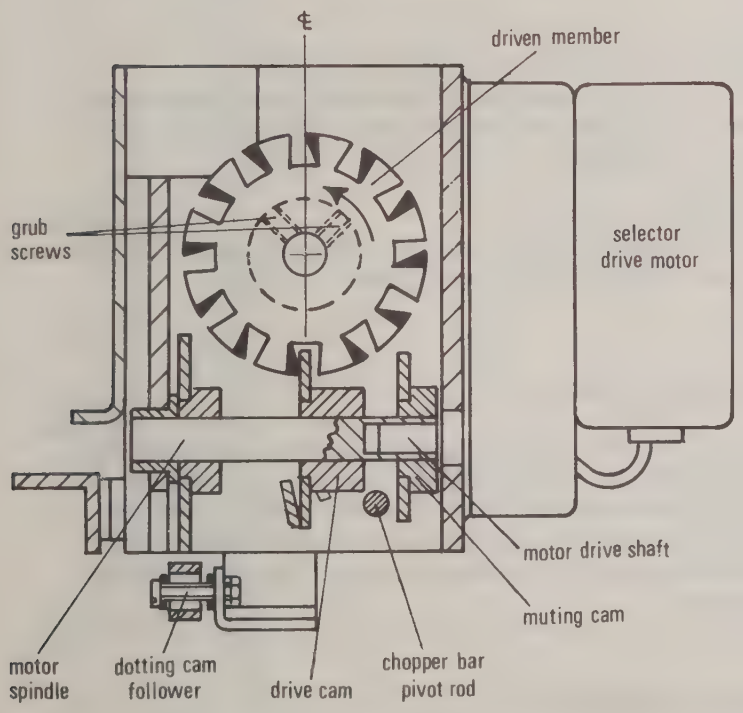


Fig. 45. Selector Drive Cams.

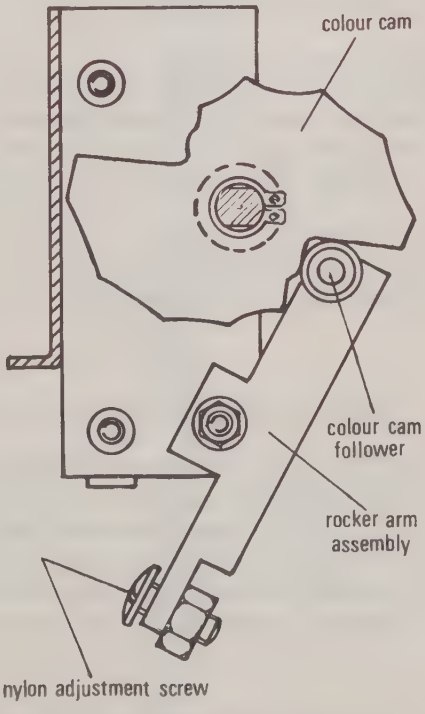


Fig. 46. Colour Cam/Rocker Arm Assembly.

To replace the Ribbon Frame Return Spring – see Fig. 42

A return spring is fitted either side of the chart unit assembly and secured at one end by a 6 BA screw which is locked in position.

Release the lock nut and screw, unhook the opposite end from the ribbon frame and replace faulty spring.

To replace the Driven Member – see Fig. 45

Separate the linear motor assembly from the main chassis – see page 52.

Undo the 4 BA screws securing the selector drive assembly to the main chassis.

Remove the circlip which retains the right hand colour cam. Slacken the 6 BA grub screws which secure the right hand spacing collar and those which secure the driven member to the secondary drive shaft. Slide the colour cam and spacing collar off the shaft.

Withdraw the secondary shaft from the motor extrusion as far as is necessary to remove the driven member.

Slide the replacement on to the secondary shaft, pass the shaft through the extrusion as far as it will go. Refit the spacing collar close up to the extrusion and tighten the grub screws to secure it. Refit the colour cam and engage the circlip. Align the driven member with the axis of the motor drive spindle ensuring that the drive cam engages correctly – see Fig. 55 and refer to alignment procedure on page 72.

Lock the driven member on to the secondary shaft by tightening the grub screws.

Finally check that there is sufficient clearance between driven member and muting switch before continuing with final assembly.

To replace the Colour Cams – see Fig. 44

Left Hand Colour Cam
Separate the linear motor assembly from the main chassis as described on page 52.
Undo the four 4 BA screws securing the selector drive assembly to the main chassis. Remove the circlips which contain the colour cam and slide the cam off the shaft. When fitting a new cam ensure that the cam bush is towards the end of the shaft.

Right Hand Colour Cam
Remove the circlip which retains the cam in position and slide the cam off the shaft.
When fitting a new cam ensure that the cam bush is towards the extrusion.

To replace the Spool Ratchet non-return Spring – see Fig. 47

Remove the 8 BA locknuts and washers and discard the faulty spring. Fit the new spring, replace the locknuts and washers but do not tighten. Adjust the position of the spring in its slots so that the arm engages in the spool ratchet. Tighten the 8 BA locknuts. Check that as the ratchet wheel rotates, the ratchet non-return spring advances by one tooth each time the ratchet lever is operated. This operation can be carried out manually. Do not attempt to make any additional adjustment by bending the arm of the spring.

To replace the Ratchet Lever Return Spring – see Fig. 47

Release the 8 BA nut and lift the spring off the studs.

To replace the Face Cam and Drive Gear Assembly — see Fig. 48

Remove the chart drive motor from its mountings —see page 63. Undo the grub screws securing the face cam assembly to the motor shaft and slide it off.

When fitting a new assembly ensure that the ratchet lever is positioned correctly against the face of the cam and the brass drive gear is not rubbing against the chart drive chassis when meshed with the idler gears.

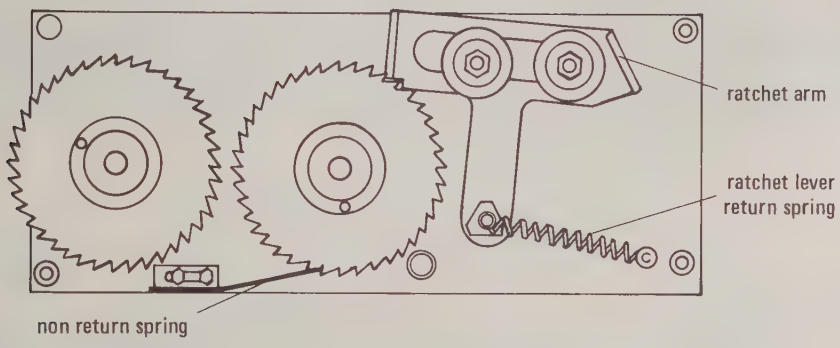


Fig. 47. Chart Unit Sub-frame Assembly.

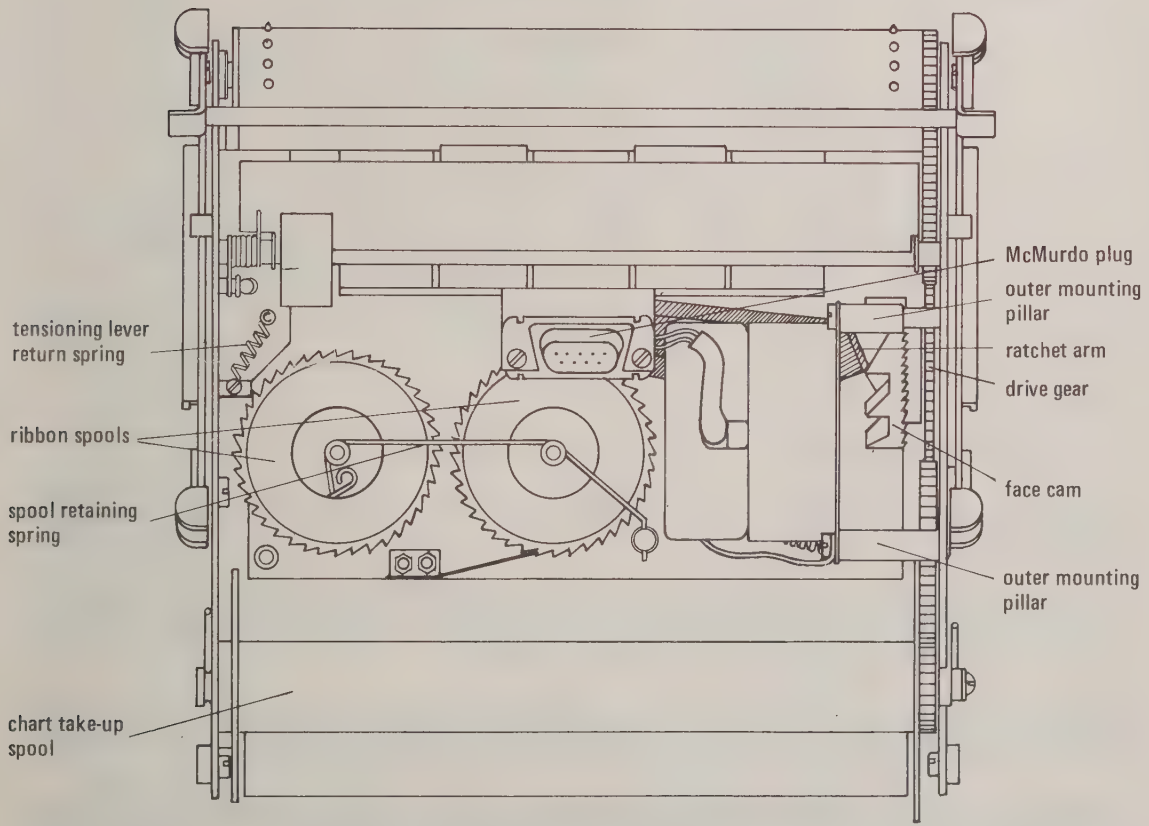


Fig. 48. Chart Unit Assembly — Chart and Ribbon Drive.

To Fit a new ribbon — see Fig. 49

Remove the chart unit from the instrument. Place it front downwards on a flat surface. Remove the empty ribbon spool by lifting the spool retaining clip out of the notches in the spindles. Put the new ribbon spool in place of the empty one and thread the ribbon through the slot in the chart frame next to the spool. Pass it inside the ribbon cover to the top of the ribbon frame, across the top, down the other side (inside the ribbon cover) and through the slot in the chart frame. Take the end of the ribbon round the guide pin and attach it to a prong inside the empty spool so that the ribbon will wind on to the spool when it is rotated anti-clockwise. Remove the spool of used ribbon and replace it with the empty take-up spool. Rotate the full spool to take up the ribbon slack and replace the spool retaining clip.

Replace the chart unit in the recorder first lifting the lever on the right to engage the chart unit retaining latch and then pushing the lever down firmly to its original position. Take up any remaining ribbon slack by means of the ribbon tensioner, see Fig. 37. The tensioner is spring loaded vertically and by repeatedly pressing the tensioner arm down the ribbon feed spool may be ratcheted round thus taking up the ribbon slack. Make sure the ribbon is under the printing stylus.

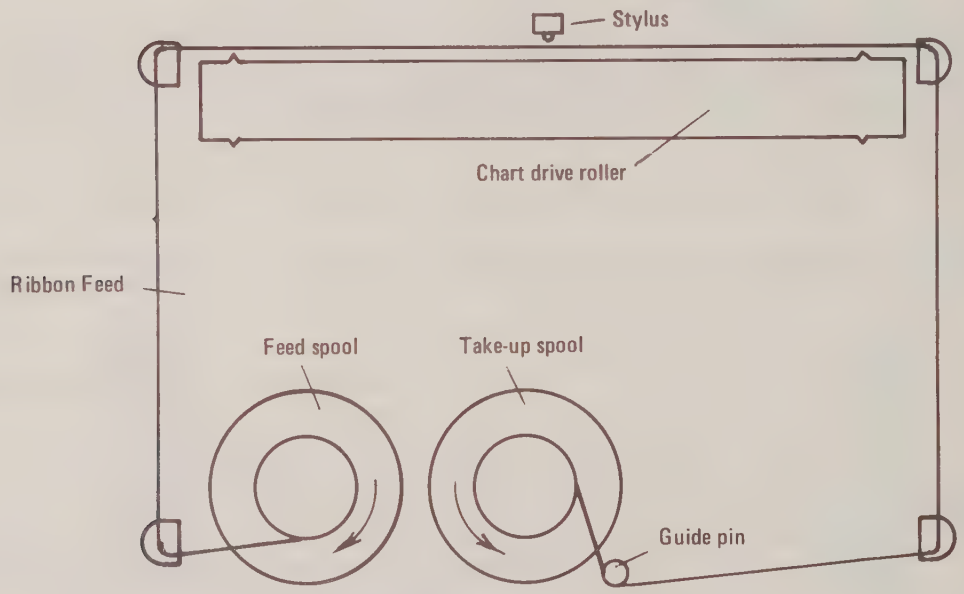


Fig. 49. Ribbon Feed

To fit a Chart — see Fig. 50

Disconnect the chart unit from the main chassis by pushing up the lever on the right and lifting the unit out.

Lift the curved paper roll retaining plate by pressing the finger plate and remove the cardboard tube from the old roll. Drop the new paper roll into the space behind the drive roller. The free end of the chart must come up from the front of the roll.

Draw out about one foot (300 mm) of paper and bring it down over the front of the cassette, passing it between the ribbon and the top roller. Lay the cassette on its front.

Disengage the take-up spool from its spring retainers and lift it clear of the drive gear. Remove the old chart from the spool. The plain end of the spool is detachable to allow the paper roll to slide off.

Keeping the take-up spool the right way round, tuck the free end of the chart into the slot in the central cylinder, wind on the first few turns ensuring that the paper is running straight and central. The free end of the chart must be cut or folded to a central point before fitting unless it is already tapered.

Drop the spool back into its slots and press it home. Take up the loose paper by rotating the serrated end of the spool. Take up the ribbon slack by rotating the ribbon feed spool anti-clockwise.

Inspect the chart run to ensure that the chart drive pegs fit into the holes in the chart correctly and replace the cassette in the recorder, first lifting the lever on the right to engage the chart unit retaining latch and then pushing the lever down firmly into its original position.

Take up any remaining ribbon slack by means of the ribbon tensioner as described in **"Fitting a new ribbon"** above.

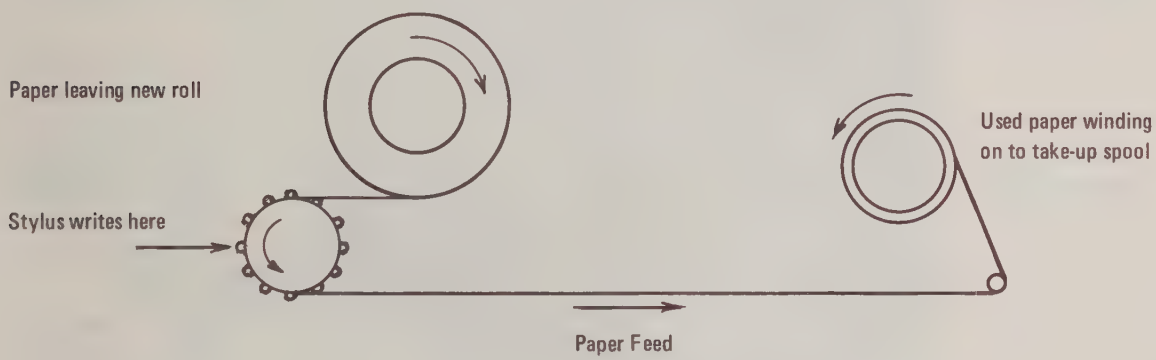


Fig. 50. Chart Feed.

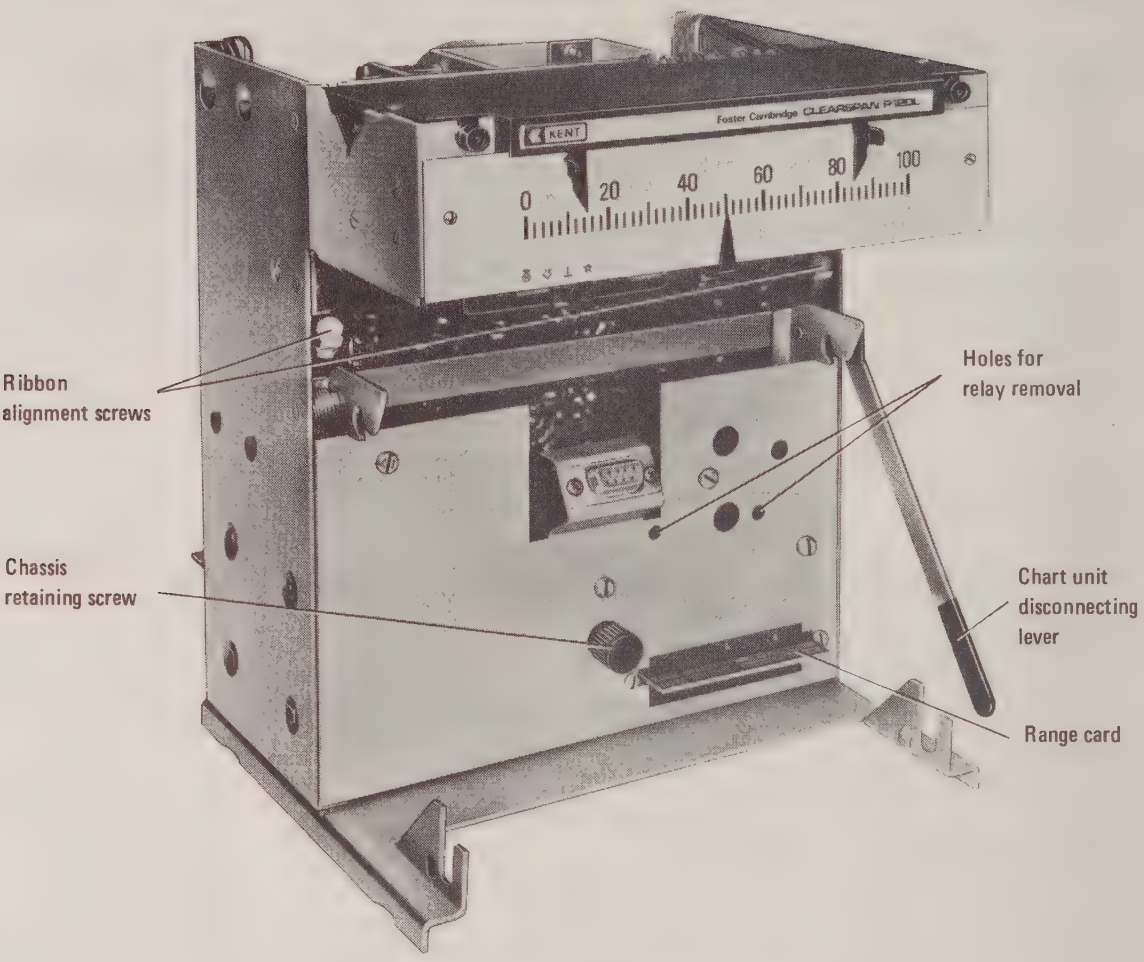


Fig. 51. Front view of Main Chassis.

Changes to Instrument Operation — see Fig. 51

Before changes to instrument operation can be effected the main chassis must be removed from its case.

Removing the Instrument from its case

Remove the chart unit by pushing up the lever on its right and lifting the unit out. Unscrew the chassis retaining screw in the centre of the main chassis about ten turns anti-clockwise. The chassis can then be completely removed from its case.

Changing the scale — see Fig. 51

Remove the chassis from its case. Remove the two screws holding the scale in place. With the pointers at mid-scale carefully slide the scale sideways taking care not to damage the pointers or scratch the scale. Dirt or grease marks on the scale can be removed by lightly rubbing them with a cloth pad soaked with Genklene supplied by I.C.I.

Changing Range — see Fig. 51

The range-card plugs into a horizontal slot in the front of the main chassis. Each range-card is labelled with its range. To change the range, first remove the chart unit. Withdraw the existing range-card. Insert the new card in the slotted guides, track side uppermost, and press firmly into position. Re-check zero and span settings as described under **CALIBRATION AND ALIGNMENT PROCEDURES.**

Changing the Chart Speed

There are six standard chart speeds, 5, 10, 20, 30, 60 and 120 mm/hr. obtained from six different chart drive assemblies. The exposed mechanism is the same but the geared synchronous motor differs. The motor can be changed if a different speed is required, but if frequent changes are to be made, it is more convenient to have complete cassettes of the required speeds ready for use. In this way, the speed can be changed in a few seconds.

Broken Sensor Protection

Upscale drive may be changed to downscale drive or vice versa by moving a resistor R12 in the range-card, as shown in Fig. 20. This resistor is not normally fitted on millivolt instruments.

Relay Energizing Above and Below Set Point

To invert the mode of relay operation, i.e., change from energizing above (E.A.) to energizing below (E.B.) the set point or vice versa, withdraw the instrument from its case. Remove the four screws fastening the amplifier printed circuit board to the rear of the main chassis and fold it back to the position shown in Fig. 40. The alarm printed circuit board can now be seen and on the left hand side are the groups of turret tags shown in Fig. 52. Resistors are fitted between pairs of tags as shown.

To facilitate the change in resistor position — EA to EB or vice versa — detach the emitter-follower pcb from the bulkhead. Remove each pair of set point resistors completely from their respective solder tags and resolder in the required position. Avoid applying excessive mechanical stress to the resistors and use as little heat as possible, as both board and resistors are liable to damage by overheating.

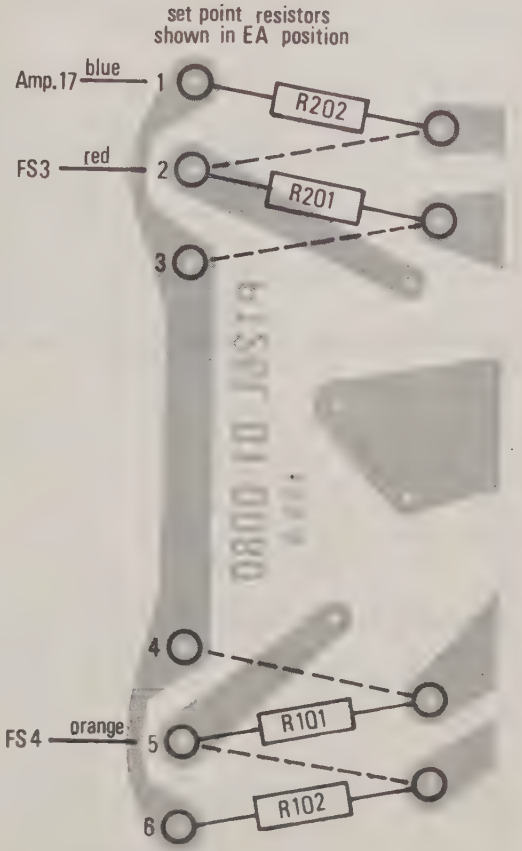


Fig. 52. Set Point Resistors.

Setting Up

The signal channel being monitored is indicated by the Channel Indicator on the left hand side of the Chart Unit. (See Fig. 37). To stop the recorder on a particular channel, lift the chart unit disconnecting lever. Do not lift the lever whilst the recorder is in the process of dotting.

Zero and span controls are accessible, when the chart unit is removed, above the main chassis in the positions shown in Fig. 14 and may be adjusted with a screwdriver.

On thermo-electric and millivolt instruments, the zero should be checked as a precautionary measure. On 2 lead resistance thermometer instruments, the lead balancing potentiometers must compensate for the lead resistance. On 3 lead resistance thermometer instruments the zero and span should be checked as a precautionary measure.

Note that recorders should be ordered specifically for two lead or three lead thermometers, since recorders intended for two lead thermometers have leads balance potentiometers fitted, but recorders intended for three lead thermometers do not. In the latter instruments the third leads are commoned together.

When carrying out the setting up procedures, it is necessary to stop the recorder on a particular channel. To do this first open the door of the recorder. With the power supply switched on note the number shown by the channel indicator on the left hand side of the chart unit and stop the instrument on this channel by raising the chart unit disconnecting lever on the right hand side. During the time when the recorder is changing channels the servo system is muted so do not stop the instrument whilst the channel indicator is moving.

Millivolt Instruments

The terminal label, Fig. 53, shows the position of the signal lead connections, marked + and — and numbered 1 to 6.

Connect the signal leads observing the correct polarity. Use insulated copper wire of 1/2.5mm^2 or equivalent gauge. Use screened cable if interference is a problem, connecting the screen to the earth terminal on the recorder. Switch on, and allow 10 minutes for the circuits to stabilise. Stop the recorder on channel 1. Short the input terminals together or inject a voltage corresponding to the zero reading and check that the indicating pointer is in line with the zero mark. Adjust zero control if necessary. The span can be checked in a similar manner. A convenient instrument for checking the calibration is the Foster Cambridge Portable Potentiometer type PP320.

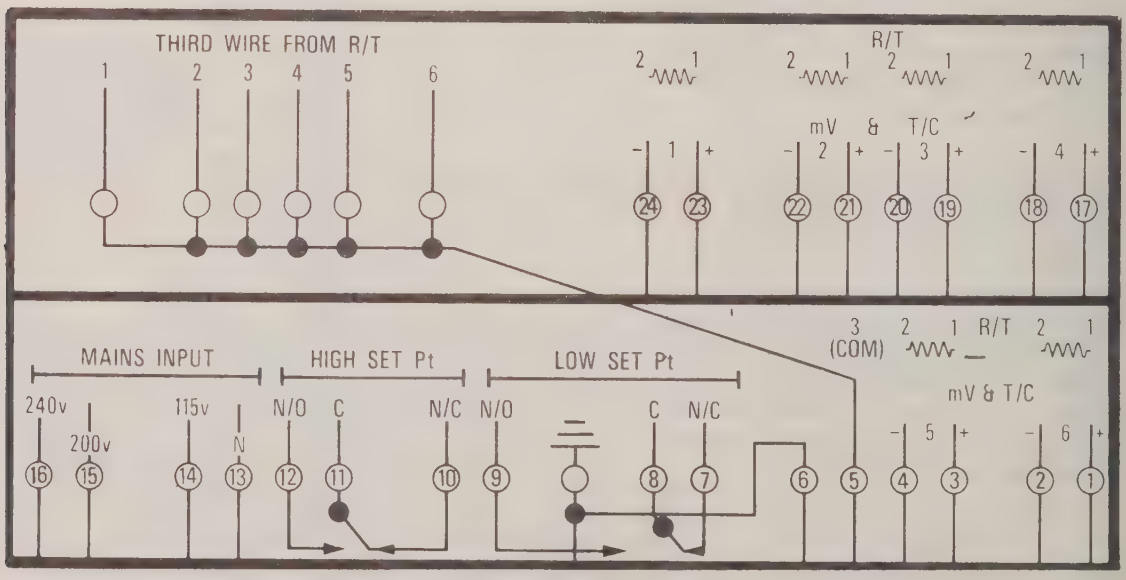


Fig. 53. Connection Label — 3 lead R/T, T/E or mV Instrument.

Thermocouple Instruments

Cold junction compensation is built into all thermo-electric instruments, so no actual cold (reference) junction is required. Compensating cable of the correct type must be used between the thermocouple and the recorder, according to this table:

Type of Thermocouple	Standard No.	Compensating Cable +	Compensating Cable –	Casing Colour
Copper-Con 'T'	BS4937 part 5 (was BS 1828)	Copper (White)	Con. (Blue)	Red
Iron-Con 'J'	BS4937 part 3 (was BS 1829)	Iron (Yellow)	Con. (Blue)	Black
Ni/Cr-Ni/Al 'K'	BS4937 part 4 (was BS 1827)	Copper (White)	Con. (Blue)	Red
Pt-Pt/Rh 'S' & 'R'	BS4937 parts 1 & 2 (was BS 1826)	Copper (White)	Copper/Nickel (Blue)	Green
Ni/Cr-Con 'E'	BS4937 part 6 NBS 561	Chrome (Brown)	Con. (Blue)	Brown

Thermocouple Compensating Cables

Correct polarity must be observed. It may be necessary to use screened cable if interference is a problem, connecting the screen to the earth terminal on the recorder. Switch on and allow 30 minutes for the circuits to stabilise. Stop the recorder on channel 1.

(1) Measure the ambient temperature at the rear terminals of the instrument.
(2) Obtain the equivalent voltage for this temperature from tables.
(3) Look up the voltage corresponding to scale minimum.
(4) Subtract the voltage in step (2) from that obtained in step (3).
(5) Inject this voltage at the signal terminals and adjust the zero control to bring the pointer to scale minimum.
(6) If necessary adjust the span control to set full scale indication in a similar manner to steps (1) to (5).
(7) If a span adjustment has been made recheck the zero setting using steps (1) to (5).
(8) Connect the thermocouple wires to the rear terminals taking care to observe correct polarity.

Resistance Thermometer Instruments (2 lead)

Two-lead thermometers may be connected either way round, see Fig. 54. Connect the signal leads to the recorder, using screened cable if electrical interference is a problem.

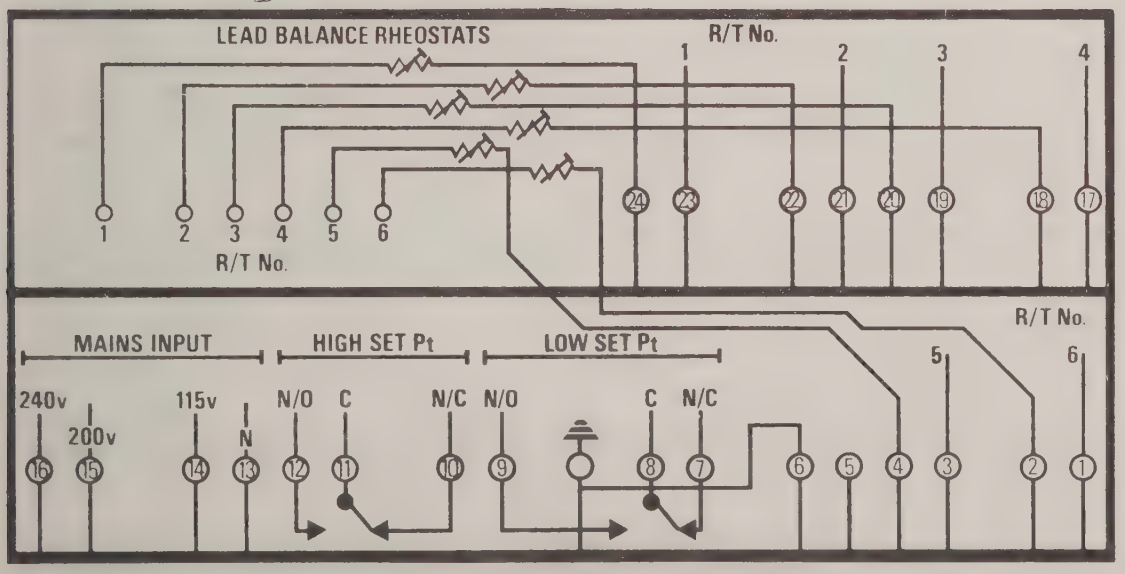


Fig. 54. Connection Labels – 2 Lead R/T only.

Lead Balancing (2 lead resistance thermometers only)

The resistance of the leads is a very important factor in two lead resistance thermometer connections, since it causes a zero shift which must be corrected by adjusting the appropriate leads balance rheostat. Up to 5 ohms lead resistance is permissible — equivalent to:

96 m of double run 24/0.20 mm^2 copper wire
190 m of double run 30/0.25 mm^2 copper wire
90 m of double run 1/1.5 mm^2 copper wire
145 m of double run 1/2.5 mm^2 copper wire

Maximum permissible cable lengths.

The leads balancing rheostats are accessible from the rear of the instrument under a cover above the terminal blocks. They are numbered 1 to 6 to correspond with the appropriate channel numbers on the recorder and should be adjusted as follows:

Stop the recorder on channel 1. Connect the test coil in place of the appropriate thermometer at the sensor end of the input cable. Switch on and allow 10 minutes for the circuits to stabilise. Adjust the lead balancing rheostat for that input until the pointer indicates the temperature marked on the test coil.

If a test coil is not available, use a resistance box instead, referring to appropriate resistance thermometer tables. (It will then be possible to check zero and span settings.)

Select another channel, and insert the test coil or resistance box. Adjust the lead balancing rheostat for that channel until the recorder indicates the same value as before. Repeat for the remaining channels. Re-connect the chart unit.

Resistance Thermometer Instruments (3 lead)

Three lead thermometers must be connected with all three leads wired to the appropriate terminals, see Fig. 53. Note that leads 3 (C) and 1 (A) are connected to one end of the thermometer, lead 1 (A) being taken to the signal input terminal on the recorder which is marked + and lead 2 (B) to the signal input terminal marked —. A common connection is made to each thermometer via lead 3 (C), these being connected together at the recorder as shown in Fig. 53. Connect the signal leads to the recorder using screened cable if electrical interference is a problem.

Stop the recorder on channel 1. Connect a test coil in place of the thermometer, connecting lead 3 (C) with lead 1 (A) to one terminal of the test coil. Adjust the zero control until the pointer indicates the temperature marked on the test coil.

If a test coil is not available use a resistance box instead, referring to the appropriate resistance thermometer tables. It will then be possible to check both zero and span settings. Reconnect the chart unit.

The other channels should not require to be set up. If the calibration is found to be different on different channels refer to **FAULTS IN THE CHART UNIT AND SELECTOR DRIVE SYSTEMS.**

Set Pointer Adjustment — see Fig. 51.

Each set pointer may be adjusted by using thumb and finger to grip the small projection on the pointer and slide it along the scale.

A small preset potentiometer is provided on the Relay Alarm pcb to align set point operation with the position of the pointer on the scale — see Fig. 40. The high set point potentiometer is positioned above the low set point potentiometer, the range of adjustment is typically 1% of span.

Alignment of Selector Drive System

Alignment is best carried out with the selector drive assembly detached from the main chassis.

Muting, Drive and Dotting Cams

Position the three cams on the motor spindle as shown in Fig. 55 with the cam bushes towards the drive motor. Ensure that the drive motor is secured properly to the extrusion. Pass the cam setting probe through the extrusion and cam setting holes into the far side of the extrusion.

Using an Allen key secure the muting cam to the motor spindle ensuring that the grub screws do not seat in the motor spindle slots.

Align the drive cam with the secondary shaft and driven member as depicted in Fig. 55.

Tighten the grub screw.

Position the dotting cam so that the cam is resting on the central portion of the dotting cam follower. Tighten the grub screws, withdraw the cam setting probe.

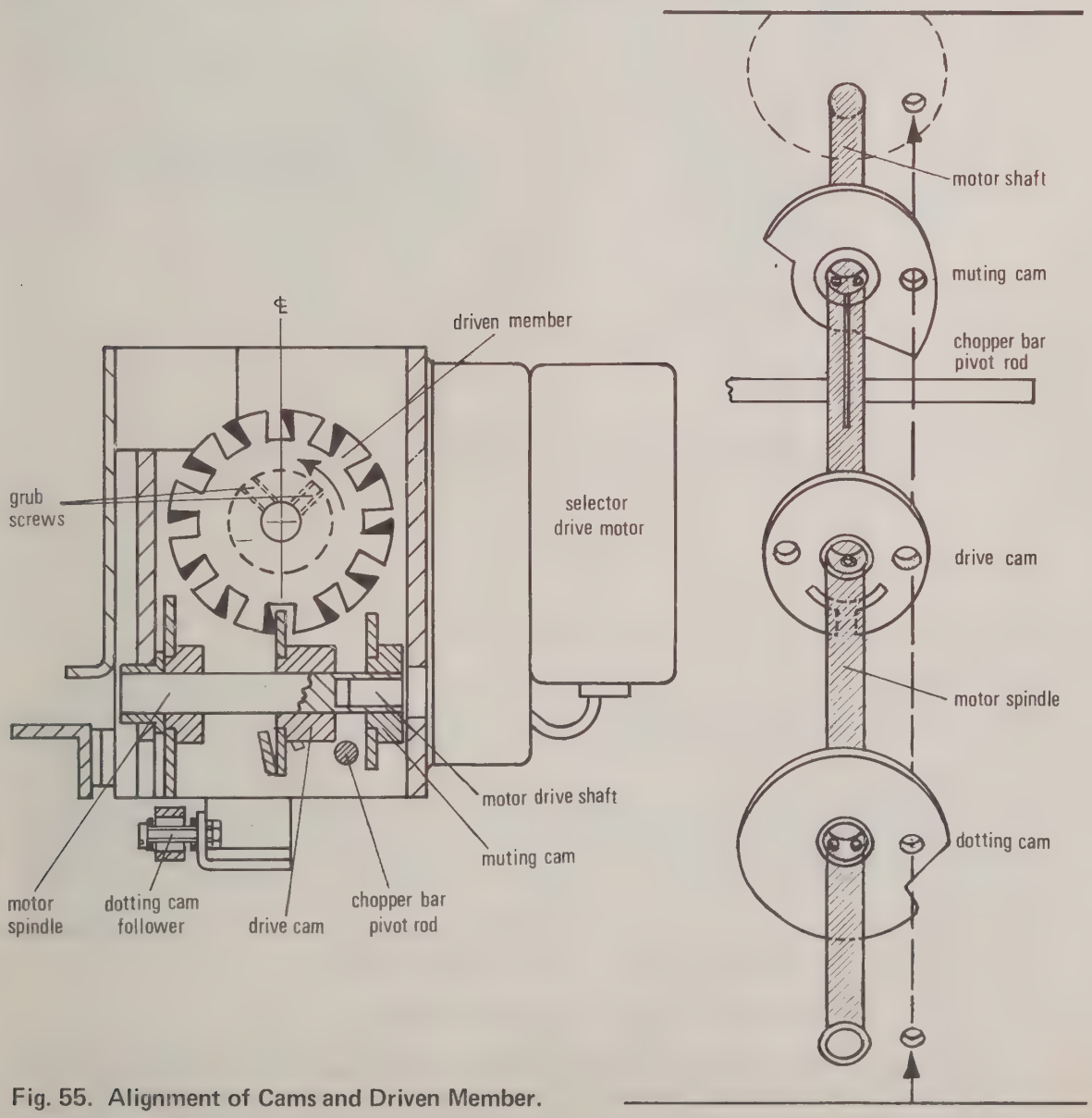


Fig. 55. Alignment of Cams and Driven Member.

Driven Member

Release the two grub screws which secure the driven member to the secondary drive shaft. The driven member should be aligned with the axis of the motor spindle and positioned in relation to the drive cam as depicted in Fig. 55. Before tightening the grub screws, check that there is sufficient clearance between the driven member and muting switch, check that the colour cam follower is positioned on the correct part of the colour cam — see Fig. 56 — and the selector switch wiper studs are aligned with the contact studs.

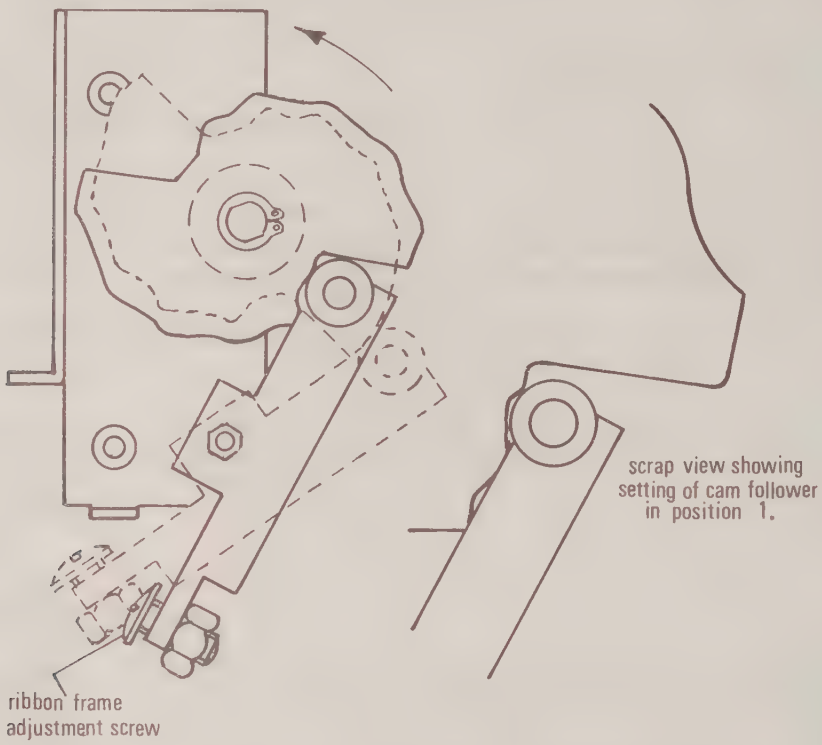


Fig. 56. Alignment of Colour Cam with Cam Follower.

Colour Cams, Ribbon Frame and Selector Switch

When the colour cam is turned at fixed intervals, movement of the ribbon frame to its six required positions is imparted by the cam follower as it traverses one half of the colour cam and comes to rest in six coincident positions.

The cycle is repeated over the second half of the cam. Fig. 57 shows the 'rest positions' which the cam follower should take up for each of the six input signals. As the cam follower moves from position 6 to position 1, the ribbon frame is moved from its most forward position to its fully retracted position hence correct positioning at these two points is essential — see Fig. 56.

To correct misalignment stop the recorder by switching off the mains when the driven member comes to rest in a position where access to its grub screws is possible.

Do not stop the instrument while the driven member is moving.

Using an Allen key, release both grub screws and turn the left hand colour cam by hand until the cam follower is seated correctly in colour cam position 1. This is depicted in Fig. 56.

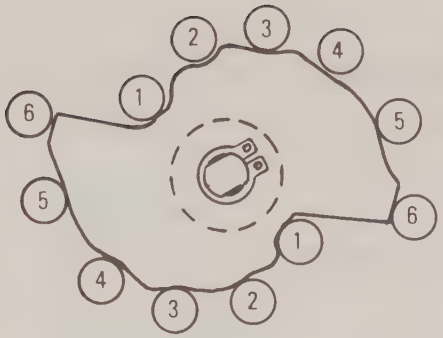
At position 1 the channel indicator should be at its highest point of travel and the ribbon frame fully retracted. Check the alignment of the ribbon frame by viewing along the length of the ribbon while moving the linear motor carriage manually. The outer ribbon colour should lie below the stylus at all positions along the scale.

Alignment may be corrected by turning one or both of the ribbon frame adjustment screws — see Fig. 56 — after first releasing their respective locknuts. Clockwise rotation of the screws will position the frame further towards the rear of the instrument and vice-versa.

When the re-alignment of the colour cams and ribbon frame is complete, re-align the driven member on the secondary shaft — see page 72 — and tighten the grub screws.

Finally, check that the selector switch wiper is aligned with the stud contacts associated with colour cam 'position 1', viz., stud contacts 2 and 14 — see Fig. 57. If correction is necessary, release the two 8 BA hexagon head screws and turn the rotary arm in the appropriate direction.

Re-tightening of the screws should be carried out very carefully, they should not be more than 'hand taut'.



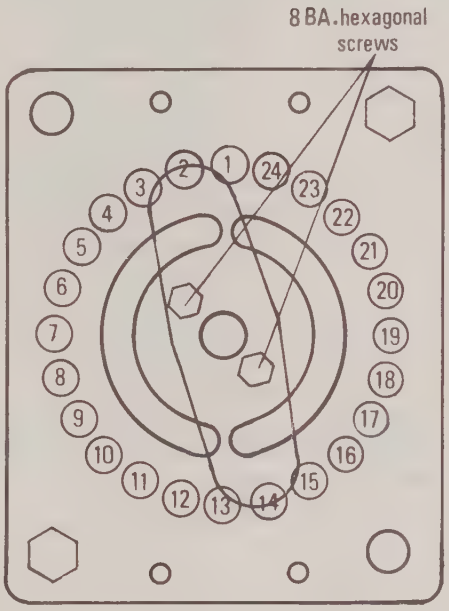


Fig. 57. Alignment of Selector Switch.

The table below shows the relationship between the cam follower position, channel number and associated ribbon colour.

Cam Follower Position	2 Point		3 Point		6 Point	
	Channel Number	Ribbon Colour	Channel Number	Ribbon Colour	Channel Number	Ribbon Colour
1	1	Red	1	Red	1	Red
2	2	Black	2	Black	2	Black
3	1	Red	3	Green	3	Green
4	2	Black	1	Red	4	Brown
5	1	Red	2	Black	5	Orange
6	2	Black	3	Green	6	Violet

SPARES LIST

Description	Part Number
Chart	Quote number on chart supplied or on range board fitted
Chart cassette Chart drive motor	Quote frequency and chart speed
Chart frame return spring	B5763
Face cam/Drive gear assembly	P126L/16/1146
Ratchet return spring	P126L/16/1127
Ribbon spool ratchet on return spring	P126L/16/1098
Spool with new ribbon:	
6 colour	P126L/06/0554
3 colour	P126L/03/0254
2 colour	P126L/02/0154
Ribbon tensioner return spring	B5834
Scale	Specify range & signal sensor
Test coil (for resistance thermometer only)	Specify resistance or equivalent temp.
Range card — see note on page 75	Specify range & signal sensor.
Range card connector — 16 way	B3260
Linear motor (Ball-race type):	
Recorder only — assembly	P120L/21/1088
Two Step Recorder — assembly	P120L/22/1120
Three Step Recorder — assembly	P120L/23/1160
Slidewire	P130L/21/0002
Indicating pointer contact sub-assembly	P125L/21/1360
Set pointer contact	P130L/22/0155
Set pointer adjusters:	
Blue	P126L/22/1452C
Red	P126L/22/1452B
Stylus arm	P126L/21/1374
Umbilical cord	P130L/21/0003
Neon indicator (Red)	B3349
Fanning strip — 8 way	B5783
Fanning strip terminal connector	P120L/21/1091
Linear motor (instruments prior to mid 1974):	
Recorder only — assembly	P126L/21/1351
Two Step Recorder — assembly	P126L/21/1451
Three Step Recorder — assembly	P126L/21/1551
Slidewire	P130L/21/0002
Indicating pointer contact sub-assembly	P126L/21/1363
Set pointer contact	P130L/22/0155
Set pointer adjusters:	
Blue	P126L/22/1452C
Red	P126L/22/1452B
Stylus arm	P126L/21/1365
Umbilical cord	P130L/21/0003
Neon indicator (red)	B3349
Fanning strip — 8 way	B5783
Fanning strip terminal connector	P126L/21/1360
Plug and socket extension lead assembly	P126L/00/0023

SPARES LIST (continued)

Description	Part Number
Amplifier pcb assembly	P126L/01/0087A
Alarm pcb:	
Two Step assembly	P126L/01/0082
Three Step assembly	P126L/01/0081
Relay	B4961
Emitter follower pcb assembly	P126L/01/0099
Power supply unit	P130L/01/0011
McMurdo plug	B4003
McMurdo socket	B3974
Selector drive assembly	P126L/10/0781
Selector drive motor (6 rpm)	B5773
Muting switch	P126L/10/0810
Muting cam	P126L/10/0798
Drive cam	P250L/91/3907
Dotting cam	P126L/10/0797
Driven member	P126L/10/0811
Selector switch (wired)	P126L/01/0061
Colour cam	P126L/10/0785
Chopper bar return spring	B4664
Hybrid amplifier pcb	P126L/01/0103A
Mains transformer (for use with hybrid amplifier)	P130L/01/0004
Integrated circuit alarm pcb:	
Two Step assembly	P125L/01/0093
Three Step assembly	P125L/01/0094

When ordering a range card state whether for use with a Hybrid Amplifier or Discrete Component Amplifier.

For information on other spare parts or kits contact your local service centre.

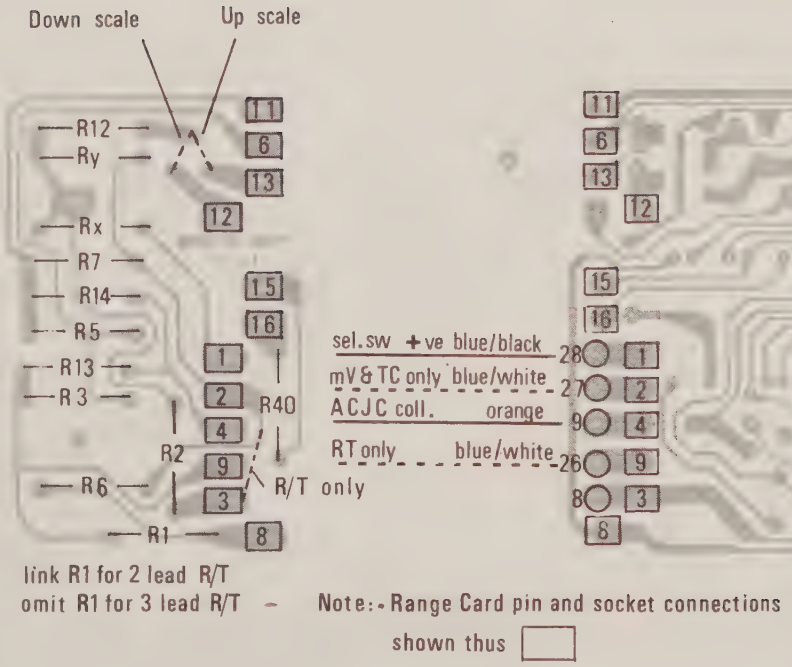


Fig. 58 Range Card

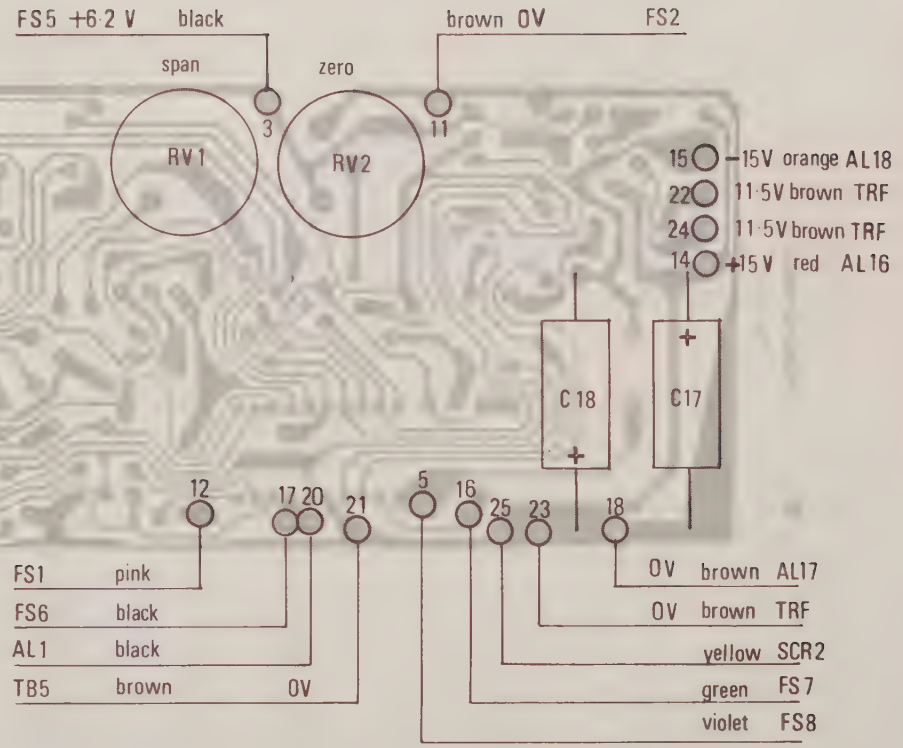


Fig. 59 Hybrid Amplifier pcb Type P126L/01/0103A

Hybrid Amplifier Instruments — see Figs. 58 and 59.

Some instruments may be fitted with an amplifier in which a hybrid module and thick film resistor package have been incorporated.

While basic changes in design and construction of printed circuit boards have been introduced, the principles of operation remain the same. The main difference lies in the amplifier pcb which accommodates the hybrid measuring circuit, power supplies and 'plug in' range card.

The secondary power supplies of 11.5V: 0V: 11.5V AC are connected direct to the amplifier pcb where provision is made for the production of the +15V: 0V: −15V DC operating voltages which supply the measuring amplifier and relay/alarm pcb circuits. The +15V rail also supplies the constant current generator and voltage regulating element to provide a high stability voltage reference source of approximately +6.2V for the input ranging circuit and feedback slidewire. The span and zero potentiometers have been re-positioned on the amplifier pcb and, at the same time, their relative positions have been reversed.

The use of a 16 way edge connector/range card assembly, emitter-follower pcb and power supply unit pcb is discontinued in hybrid instruments.

Replacing an Amplifier pcb.

This may be carried out in accordance with the instructions on page 56. It should be noted however, that while a hybrid amplifier pcb is basically similar to pcb's of earlier design, it is not directly interchangeable.

If a hybrid amplifier pcb is fitted to an instrument of earlier design, major wiring changes are necessary and therefore, new wiring harnesses have to be fitted. This should be carried out in the workshop by an experienced instrument technician as it is outside the realm of normal field servicing.

Integrated Circuit Alarm pcb — See Fig. 60

This relay pcb was introduced at approximately the same time as the hybrid amplifier. Although of alternate design it is functionally the same as its predecessors and uses the same pin numbers. It may be fitted to earlier instruments as a direct replacement.

Improved control circuitry excludes the need for set balance potentiometers and any reference to these components may be ignored.

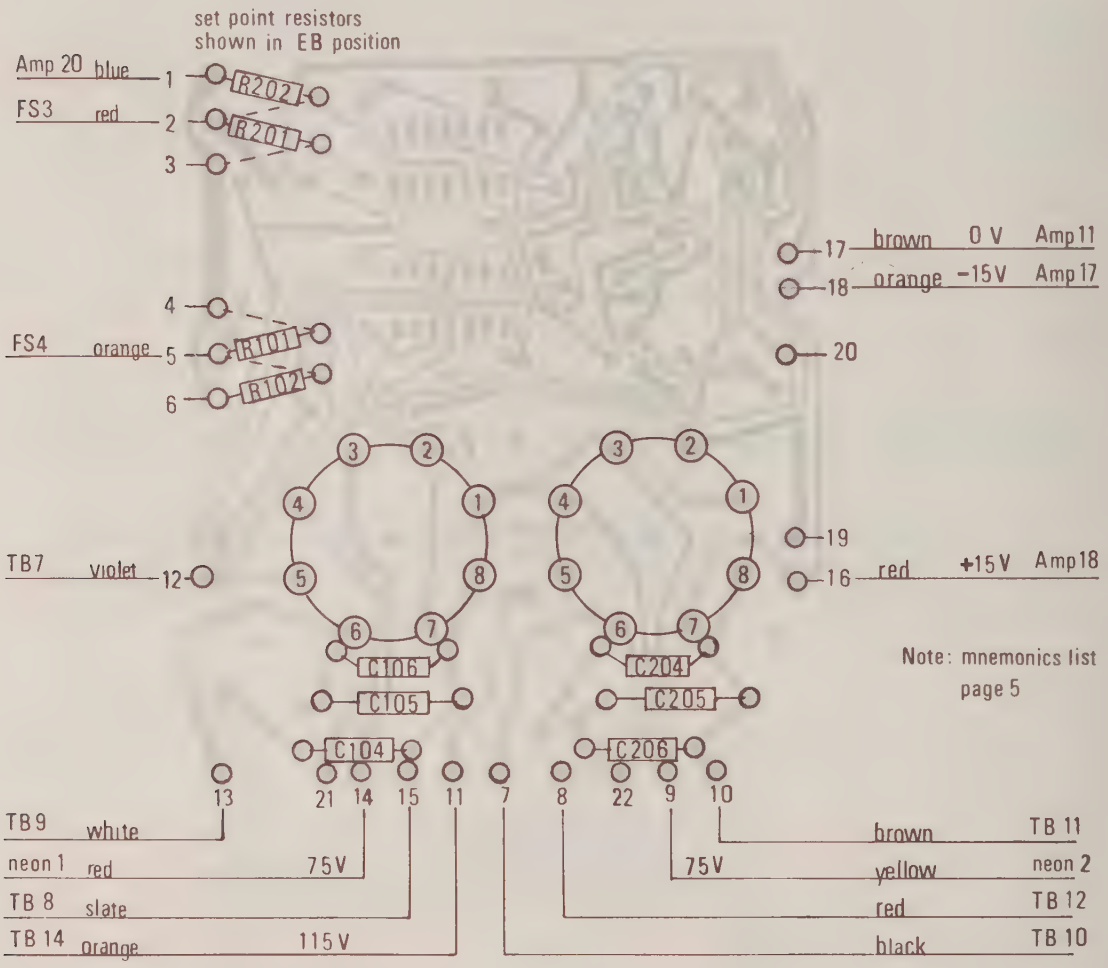


Fig. 60 Alarm pcb Type P125L/01/0094

Fault Finding Procedure

Fault finding on hybrid instruments may be carried out in accordance with the procedure described in the main text. Where differences occur, reference should be made to the explanatory paragraphs, appropriate illustrations and supplementary fault-finding tables contained in this section.

SUPPLEMENTARY FAULT FINDING TABLES – Hybrid Amplifier

The following abbreviations are used in these tables:

Avo – Avometer	PSU – Power Supply Unit	RC – Range card
HSP – High Set Point	TC – Thermocouple	T/E – Thermoelectric
LSP – Low Set Point	AMP.pcb– Amplifier printed circuit board	F. Strip–Fanning Strip
pcb – printed circuit board	Relaypcb– Relay/Alarm printed circuit board	F-C. – Foster Cambridge

TABLE S1: FAULTS IN THE INDICATING SYSTEM

No drive to Linear Motor

Note:– Move the linear motor carriage manually for tests marked thus *

	Test	Go result	Refer to	Go	No Go
	Apply an input signal which would normally drive the linear motor carriage to approximately mid-scale position.				
1	*Check for obstruction	Motor moves freely		Test 2	Clear obstruction.
2	Mains AC supply on terminal block pins 16 15 14 13	 240V 200V 115V Neutral	p.19	Test 3	Check mains supply source and leads
3	AC secondary voltage at amplifier pcb pin 22 23 24	 11.5V 0V 11.5V	Fig. 58	Test 4	Check transformer connections to terminal block and to amplifier pcb. If correct, change mains transformer.
4	DC voltage on amp. pcb pin:– 18 14 15	 0V + 15V –15V	Fig. 58	Test 5	Change amp. pcb.
5	DC voltage on amp. pcb pin 3 –	+ 6.2V	p. 21 & Fig. 58	Test 6	Change amp. pcb.
6	Remove muting switch connection to fanning strip pin 1. Switch on mains supply	Linear Motor drives	p.14	Replace micro-switch and reconnect leads to fanning strip.	Test 7.
7	* DC voltage between amp. pcb pins 16 and 5 (Linear motor coil voltage depends on indicating pointer position).	Between + 11V & – 11V	p.21	Test 8	If no voltage change amp. pcb.
8	* Linear motor coil voltage between fanning strip pins.	Between + 11V & –11V	p.21	Test 9	Check continuity between F. Strip Amp. pcb 7 16 8 5
9	Continuity of linear motor coil at coil lead outs.	68 ohms nominal	p.21	Change the umbilical cord	Change linear motor assembly.

TABLE S2: FAULTS IN THE INDICATING SYSTEM

Linear Motor movement — (A) Restricted (B) Indication inaccurate (C) Oscillatory

Note:— Move the linear motor carriage manually for test marked thus *

Test		Go result	Refer to	Go	No Go
A1	*Check for indicating pointer touching the bottom of the scale and that the umbilical cord has free movement.	Motor moves freely	p. 23	Test A2	Make necessary adjustment.
A2	Monitor DC voltage at slide-wire terminal pins using Avo prods. DO NOT USE CROCO-DILE CLIPS AS DAMAGE MAY RESULT.	+6.2V	p. 23	Clean slidewire and slidewire contacts. If the fault persists change slidewire	Voltage present but incorrect. Change amp. pcb.
B1	Carry out tests A1 and A2 together with corrective procedure.		p. 23		Indication still inaccurate. Test B2.
B2	Replace range card and recalibrate.	Indication correct	p. 27	Check faulty range card components	Test B3.
B3	Carry out voltage check between wiper and one end of zeroing potentiometer RV2 while rotating pot. over full traverse.	Varies linearly between 0 & −6.2V	p. 26	Test B4	Change RV2.
B4	Switch off mains supply. Withdraw range card. Connect ohmmeter across span potentiometer RV1. Check that resistance varies over full traverse.	Varies linearly between 0 & 47k	p. 27	Test B5	Change RV1
B5	Insert range card. Press home firmly. Disconnect switch wiper link wires from turret lugs on selector switch. Connect a F-C portable potentiometer for mV or T/E inputs, OR a decade resistance box for R/T inputs — between turret lugs on selector switch. Inject a signal equivalent to each of the normal mV or T/E signal input levels OR set the resistance box to the value appropriate to each R/T temperature.	Indication correct at each simu-lated temp.	p. 27 BS or DIN Spec. Tables	Test B6	Change amp. pcb.
B6	Check continuity between main terminal block and selector switch.	Continuity established	Fig. 22	Clean contacts and/or re-align	Repair interwiring.
C1	Monitor DC voltage at slidewire terminal pins using Avo prods.	+6.2V ±0.3V		Clean slide-wire and slidewire contacts. If fault persists change slidewire	Voltage present but incorrect. Change amp. pcb.

TABLE S3: FAULTS IN THE INDICATING SYSTEM

Linear Motor drives up or down scale — (A) Slowly
(B) Quickly

	Test	Go result	Refer to	Go	No Go
A1	Carry out test B5 in Table S2.				
B1	Switch on mains supply and check DC voltage between amp. pcb pins 9 and 11.	+0.6V ±0.03V	p.26	Test B2	Check interwiring between amp. pcb pin 9 and terminal block pin 5. If correct change ACJC transistor.
B2	Check DC voltage at slidewire termination pins using Avo prods. DO NOT USE CROCODILE CLIPS AS DAMAGE MAY RESULT.	+6.2V ±0.3V	p.23	Test B3	Voltage present but incorrect.
B3	Check the indicating pointer contact voltage with respect to amp. pcb pin 11 (0V) at amp. pcb pin 17 and fanning strip pin 6. (varies according to position of pointer).	Varies between 0V & 6V	p.25	Test B4	Repair interwiring.
B4	Unplug input signal sockets from rear of instrument. Check for short circuit between selector switch wiper segments.	No short circuit present	p.41	Test B5	Clean/re-align selector switch contacts.
B5	Carry out tests B2 to B5 in Table S2 as necessary.				

TABLE S4: FAULTS IN THE INDICATING SYSTEM

Undue sensitivity to — (A) Ambient Temperature variations
(B) Mains Voltage variations

	Test	Go result	Refer to	Go	No Go
A1	Check DC voltage between amp. pcb pins 9 and 11.	+0.6V ±0.03V	p.26 Fig. 58		Check interwiring between amp. pcb pin 9 and terminal block pin 5. If correct change transistor.
B1	Connect a 680 ohm resistor between fanning strip pins 2 and 5. Measure the voltage across the resistor.	approx. + 4V	p.23		Change amp. pcb.

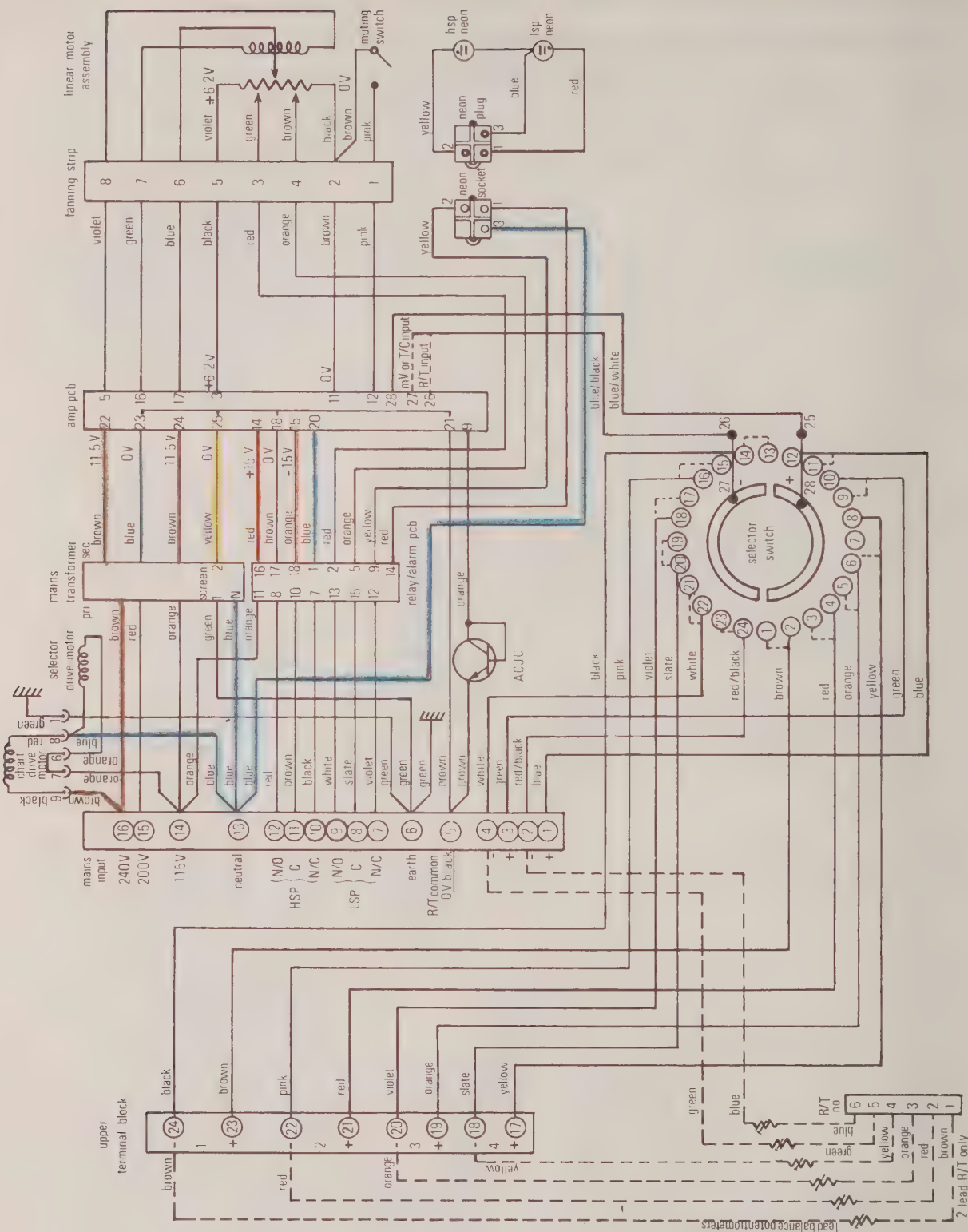


Fig. 61 Hybrid Amplifier – Six Point Wiring Diagram
High and Low Set Point (R/T, mV or TC input)

FAULT NOT TRACED

When a fault cannot be traced contact your local service centre. Try to have the following information available:

Equipment type number and serial number (see labels attached to main chassis and instrument case).

What are the fault symptons?

Is the fault intermittent or permanent?

Has the fault developed suddenly, over a period of time or since modification to plant?

What is the instrument application?

Is the instrument positioned near switch gear incorporating heavy current contactors or near machinery producing strong magnetic fields or excessive vibration?

Is the instrument subjected to extreme temperatures, corrosive gases or a high degree of humidity?

Have tests been carried out in accordance with the fault finding procedures?

What attempts have been made to effect repair?

If this instrument is to be returned to a Service Centre for repairs, clamp the motor and place foam packing between the chart unit assembly and the door glass.

To secure the motor remove the chart unit, withdraw the main chassis from the instrument case by rotating the central knob about 10 revolutions and pull the chassis forward.

Tilt the chassis sideways so that the linear motor carriage moves to the extreme left end of the scale and secure with a piece of tape across the linear motor carriage so as not to damage it. Secure the tape to a convenient point. Place the chassis in its case, refit the chart unit and position the foam packing.

Foster Cambridge SERVICE CENTRES

U.K. Service Centres

Birmingham Service Centre
Unit 14A,
Lee Bank House,
Birmingham B1 1HR
tel: 021-643 4114 or 021-643 6783

Bristol Service Centre
119A Two Mile Hill Road,
Kingswood,
Bristol BS15 1BY
tel: 0272-679151/2

Glasgow Service Centre
52 Waddell Street,
Glasgow, C.5.
tel: 041-429 3371

London Service Centre
Chaseside Works,
Chelmsford Road, Southgate,
London N14 4JW
tel: 01-882 3737/8

Manchester Service Centre
Lord Street
Manchester M3 1HL
tel: 061-832 5391/2

Newcastle Service Centre
10 Hannington Street
Newcastle-upon-Tyne NE6 1JT
tel: 0632-656126

Overseas Agents

Equipamentos Tecnicos Lda.,
P.O. Box 6319,
Luanda,
Angola.

Quimica Lode S.R.L.,
Faustina Bettran & Cia S.A.,
Of. Pinzon 1445,
Casilla de Correo 39-Suc. 33.
Buenos Aires,
Argentina.

Pryde Measurement Pty. Ltd.,
383, Swan Street,
Richmond 3121,
Victoria,
Australia,

Kent Instruments (Aust) Pty. Ltd.,
P.O. Box 333,
Caringbah N.S.W. 2229,
Australia.

Austral Engineering Supplies Pty. Ltd.,
Private Mail Bag, Post Office,
Ermington, N.S.W.
Australia.

George Kent (Europe) Ltd.,
Zweigiederlassung Wien,
Jacquingasse 39,
A-1030 Wien,
Austria.

Kent Belgium S.A.,
27 rue Paul Emile Janson,
Brussels – 1050,
Belgium.

Altmann S.A.,
Caixa Postal 3562,
Rua Florencio de Abrea 36,
Sao Paulo,
Brazil.

Kent Cambridge Ltd.,
80, Doncaster Avenue,
Thornhill,
Ontario, L3T 1L3,
Canada.

Sirex,
A. Salvador 297,
Santiago,
Chile.

Aprocin Ltda,
Apartado Aereo 13582,
Bogota,
Colombia.

Hans Buch & Co. A/s.,
P.O. Box 975
Copenhagen NV,
Denmark.

Clondalkin Engineering Co. Ltd.,
Bondworth House,
Ballymount Road,
Walkinstown,
Dublin 12,
Eire.

Kent France S.A.,
3 rue de Rosenwald,
Paris 15e,
France.

Oy Regulator AB,
Masala,
Finland.

Flexa Controls GmbH,
4300 Essen 1,
Postfach 538
Germany.

Kent Nederland B.V.
Westhovenplein 46,
The Hague
Den Haag 2032,
Holland.

Engineering Equipment Co. Ltd.,
P.O. Box 36,
Hong Kong.

J. N. Marshall & Company,
Spirax Department,
Opp. 106th Milestone,
Bombay, Poona Road,
Pimpri P.O.,
Poona 18,
India.

India Furnace Co. Private Ltd.,
12A Dr. Annie Besant Road,
Bombay,
India.

Elina Limited
Ramat-Can,
P.O. Box 2770
Israel.

Ing. Taragni & Co.,
Via Borgonuovo 14 - 16,
20121 Milano,
Italy.

Henry Coe, & Clerici,
Via M.A. Colonna,
Milan,
Italy.

The Technical Supply Co. Ltd.,
4, Central Avenue,
Rest Pen,
P.O. Box 75,
Kingston 10,
Jamaica.

Andrews & George Company Inc.,
Nichiasu Building,
No. 1–26, 1–chome.
Shiba Daimon, Minato Ku.
Toyko 105,
Japan.

G. F. Corvin Limited,
P.O. Box 30747
Nairobi,
Kenya.

Bardawil & Co.,
P.O. Box 967
Dora Blv.,
Beirut,
Lebanon.

Louis Vella Ltd.,
168 - 170, Britannia Street,
Valetta,
Malta.

Scott & Co. Ltd.,
1, Corderie Street,
P.O. Box 51,
Port Louis,
Mauritius.

George Kent (Malaysia) SDN. Berhad,
No. 2, Lorong 19 - 1A,
Petaling Jaya,
Selangor,
Malaysia.

Sociedad Electro Mecania S.A.,
Manual MA, Contreras 25,
Mexico 4 DF.

Ing. Eduardo Castell de Oro,
Av, Amsterdam N.113,
Mexico 11, D.F.

Kent Instruments (N.Z.) Ltd.,
210, Marua Road,
P.O. Box 11 - 148,
Ellerslie,
Auckland,
New Zealand.

A/S Garek
Postboks 8,
Refstad,
Oslo 5,
Norway.

N. A. Eie,
P.O. Box 19,
N. Slottsgt 4,
Oslo 1,
Norway.

Naafco (Scientific Supplies) Ltd.,
243 Iddo/Ijora Causeway,
P.O. Box 2734,
Lagos,
Nigeria.

Azam Instruments Ltd.,
Darul-Ghazali,
26, Shaheed e Millat Road,
Karachi 5,
Pakistan.

Instrument Krafts, .
Fatima Bldg.,
Khori Garden,
Karachi 2,
Pakistan.

Tijarat Agencies Ltd.,
47, The Mall,
Lahore,
West Pakistan.

C. J. Chambers & Co., Ltd.,
69, Apartado,
Porto,
Portugal.

George Kent (Singapore) Pty Ltd.,
11, Jalan Lembah Kallang,
Rendemeer Road, Industrial Estate,
Singapore 12.

C. K. F. Instruments & Electronics (Pty) Ltd.,
P.O. Box 9088,
Johannesburg 2000,
South Africa.

Kent Instruments (S.A.) Pty Ltd.,
56, Commando Road,
Industria Est 2,
P.O. Box 7396,
Johannesburg,
South Africa.

Kent Iberica S.A.,
Arroyo Fontarron 39,
Madrid (30),
Spain.

Bergman & Beving AB,
Karlavagen 76,
Fack 100,
Stockholm 10,
Sweden.

Witronic Sarl,
24, Chemin des Plateires,
1009, Pully,
Switzerland.

George Kent (Thailand) Ltd.,
189 Asoke Road,
P.O. Box 2087,
Sukhumvit 21,
Bangkok,
Thailand.

Teknim Co. Ltd.,
Riza Sah Pehlevi,
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Merkez,
Ankara,
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73, Spring Street,
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